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ABSTRACT

This packet is designed to supplement the teaching about insects at the elementary school level. It includes: (1) a set of 15 full-color insect photo cards; (2) a collection of ready-to-copy stories from the magazine "Ranger Rick"; and (3) a variety of activities that relate to the stories and photo cards and emphasize science, language arts, and social studies skills. The activities focus on both skills and content, with teaching objectives listed for each. The skills and objectives are highlighted in the left-hand margin, along with the materials needed for each activity, the subject areas covered, and the recommended age group. The stories, photo cards, and activities in this packet also have some references to portions of the "Incredible Insects" volume of the periodical "NatureScope." Also included are reproducible worksheets and handouts. (TW)

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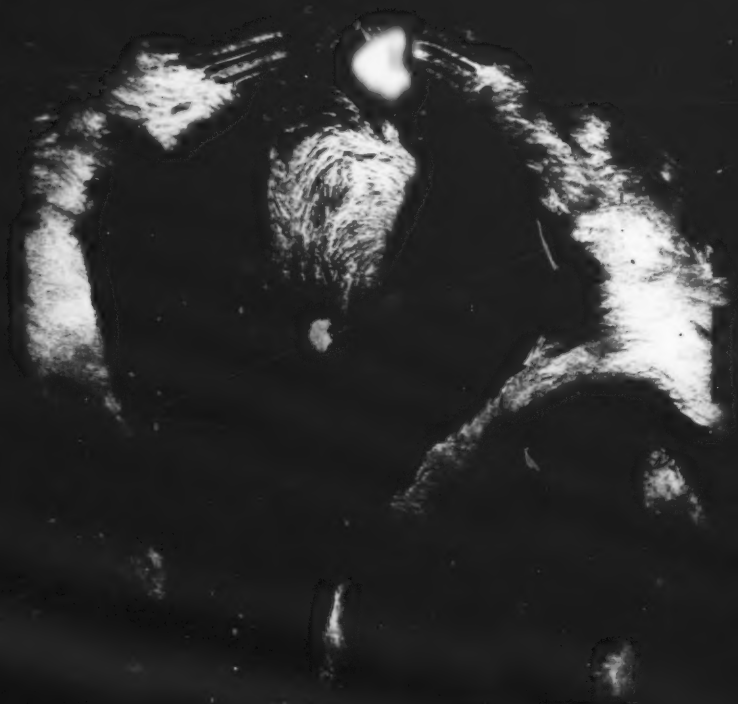

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GOALS

- to encourage creativity
- to develop thinking skills using science, language arts, and social studies activities
- to help educators teach science
- to help kids develop an awareness of and a feeling of responsibility toward their environment and community
- to encourage parents to get involved with their children's learning
- to encourage group cooperation

PHOTO PAC

1. WHAT MAKES AN INSECT AN INSECT?

About the Photo: When it comes to hopping, grasshoppers—like this eastern lubber grasshopper—are experts. Some can jump a distance 20 times their length. (Humans can jump only about 5 times their height—and that's with a running start.) But hopping isn't what makes this grasshopper an insect, of course. Lots of different kinds of animals can hop, including frogs, kangaroos, mice, and people. Grasshoppers are classified as insects because they have a combination of characteristics that makes them different from other kinds of animals.

THE SIX-LEGGED CROWD

Although there are some exceptions, most insects

- have six legs and two pairs of wings
- have three main body parts: the *head*, *thorax*, and *abdomen*
- have compound eyes as adults
- have a tough outer body covering called an *exoskeleton*
- lay eggs
- change as they grow through a process called *metamorphosis*

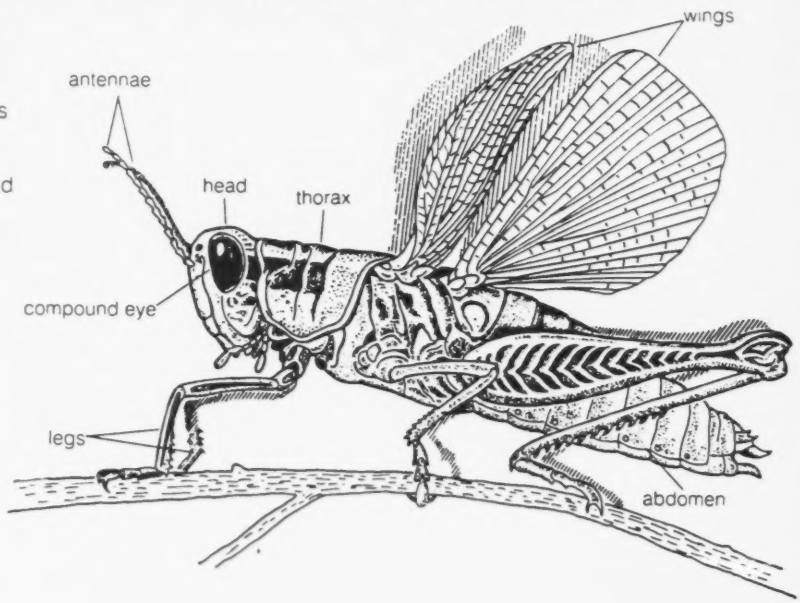


Photo by Robert L. Dunne

2. SPIDERS AREN'T INSECTS

About the Photos: This golden garden spider is using super-strong silk to wrap up a grasshopper. Like many types of spiders, it traps prey in webs made of silk. Other types of spiders, such as the jumping spider in the small photo, don't spin webs. They use their keen eyesight and strong legs to capture their prey.

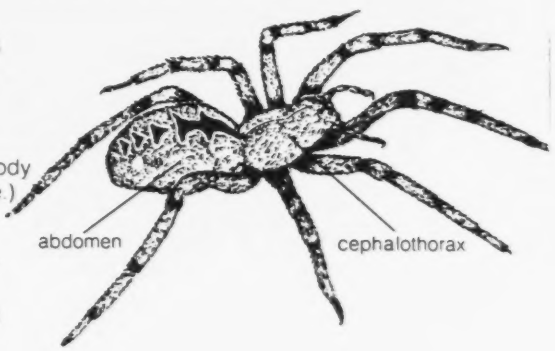
IS IT A SPIDER?

Although insects and spiders are related and have several characteristics in common (jointed legs, bodies covered with hair, skin that they shed regularly, and so on), they are different in many ways. Here's how to tell them apart:

Count the Legs: Spiders have eight legs. (Insects have six.)

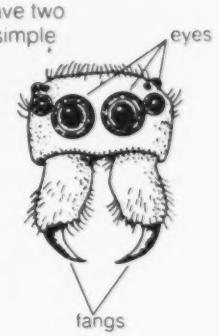
Count the Body Parts: Spiders have two main body parts. (Insects have three.)

Look for Wings and Antennae: Spiders don't have wings or antennae. (Most insects have both.)



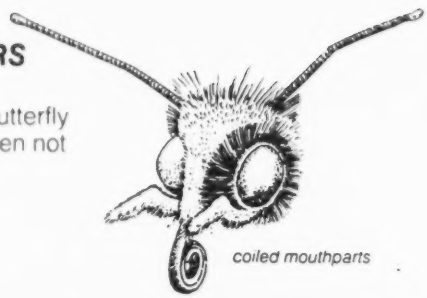
Check Out the Eyes: Most spiders have eight simple eyes, although some have fewer. (Most insects have two large compound eyes and some also have three simple eyes.)

Does It Have Fangs? All spiders are predators that kill or paralyze their prey with venom that they inject with their two sharp fangs. (Insects do not have fangs. And although many insects are predators, many feed on plant material.)



Photos by Dwight R. Kuhn (golden garden spider) and Robert E. Pelham/Bruce Coleman, Inc. (jumping spider)

3. SUCKERS, CHEWERS, LAPPERS, AND SPONGERS



coiled mouthparts

About the Photo: Like most moths and butterflies, the fritillary butterfly uses its long "tongue" to suck up sugary nectar from flowers. When not in use, the hollow tube coils under the butterfly's head.

EATING LIKE AN INSECT

The insect world is filled with suckers, chewers, lappers, and spongers. Here's more about each type of eating strategy:

Piercing-Sucking Mouthparts: Mosquitoes, aphids, bugs, and many other insects have piercing-sucking mouthparts. Like butterflies, these insects have a long siphoning tube. But inside the tube is a razor-sharp "spear" that pierces through leaf tissue, animal skin, and other surfaces. At right is a magnified view of a leaf bug's piercing-sucking mouthparts.

Chewing Mouthparts: Ants, beetles, preying mantises, grasshoppers, and many other insects are chewers. They have jawlike *mandibles* that move from side to side, crushing and tearing food.

Lapping-Chewing Mouthparts: Honey bees have a double-duty mouth. They have small jaws that they use to chew wax. And they have a quick-moving tongue that laps up flower nectar.

Sponging Mouthparts: Many flies sponge up their meals and then pump the liquid into their stomach.

Photo by Roger Artman

Photo by David Scharf

4. SUPER SENSORS

About the Photo: The feathery antennae on this male luna moth have over 30,000 sensors. These sensors are so sensitive they can detect the scent of a female moth over two miles away.

TASTE, TOUCH, SEE, HEAR, AND SMELL

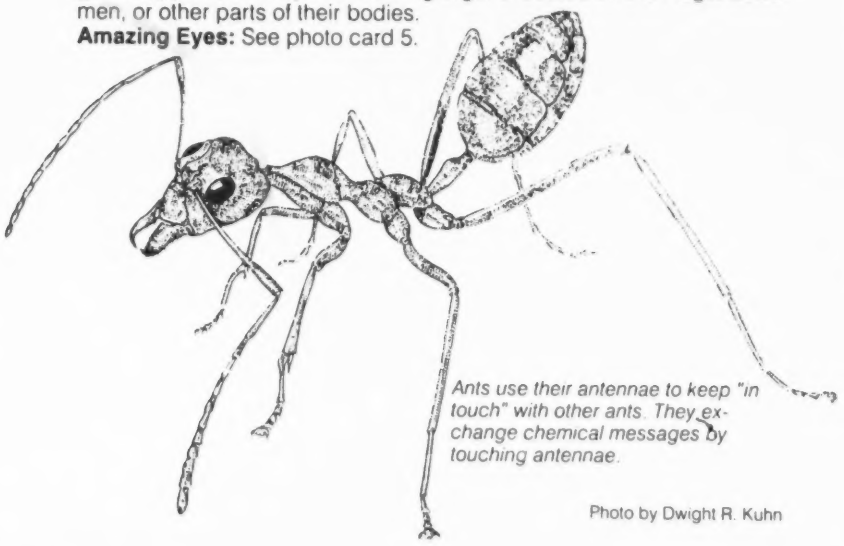
Insects use a variety of senses to find food, escape from predators, and communicate. Here's a quick look at some of the ways insects sense their environment:

Awesome Antennae: Like luna moths, most adult insects have a pair of antennae—two sensory stalks that they use to feel, smell, and in some cases, hear. Insects' antennae differ in size, shape, and function. Many insects use their antennae to pick up important chemical scents called *pheromones*.

Hairs Help: If you take a close-up look at an insect, you'll see hairs—thousands of them—covering the antennae, eyes, mouth, and other parts of the body (see photo cards 5 and 12). Insect hairs are very sensitive to air movement, pressure, smell, and in some cases, sound. Many insects also have special taste-sensitive hairs. For example, some flies and butterflies can taste what they're walking on with the hairs on their feet.

Ears in Strange Places: Many types of insects can hear. Some insects, such as mosquitoes, pick up sounds through special types of sensitive hairs on their antennae. Other insects, such as cicadas and grasshoppers, have special hearing organs located on their legs, abdomen, or other parts of their bodies.

Amazing Eyes: See photo card 5.



Ants use their antennae to keep "in touch" with other ants. They exchange chemical messages by touching antennae.

Photo by Dwight R. Kuhn

5. INSECT EYES

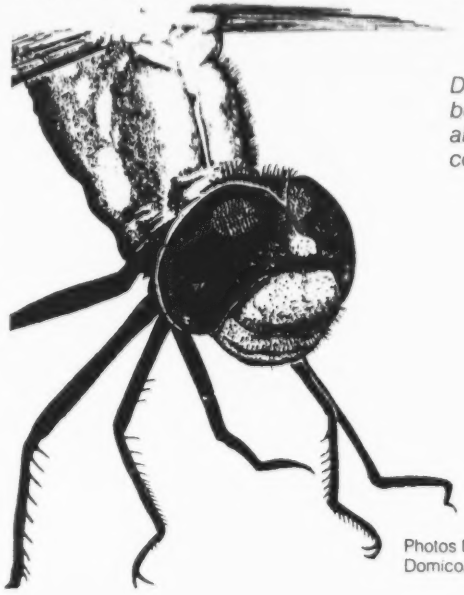
About the Photos: Honey bees and people don't see eye to eye. The photo at top right shows how a person would see the flower. But if a honey bee looked at the same flower, it would see a color that scientists call *bee purple* (top left) instead of bright yellow. Bees can also see ultraviolet markings called *nectar guides* that people can't see. These markings help guide bees to a flower's nectar.

FAR-OUT FACETS

Honey bees, like most adult insects, have *compound eyes*—eyes that are made up of thousands of tiny lenses called *facets*. Scientists think that each facet in a compound eye "sees" one small part in an insect's field of vision. The brain then takes the image from each tiny lens and creates one large mosaic-like picture. Although honey bees and other insects can see some ultraviolet markings that we can't see, most insects don't see as clearly as people do from the same distance.

SIMPLE EYES TOO

Many insects have three smaller eyes in addition to compound eyes. Scientists think these *simple eyes*, which are usually located above the compound eyes, are sensitive to light intensity but can't see images.



Dragonflies, some of the best-sighted insects, have about 25,000 facets per compound eye.

Photos by Charles Krebs (honey bee) and Terry Domico/Earth Images (flowers)

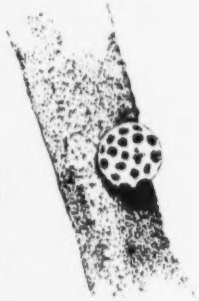
6. AMAZING INSECT EGGS

About the Photos: Looking like a clump of miniature tennis balls, these stink bug eggs (top) are ready to hatch into tiny stink bugs (bottom). Most insects are egg layers, and each type of insect lays a different type of egg.

INSECT EGG TRIVIA

Most insect eggs are smaller than one-eighth of an inch in diameter. Many are oddly shaped, and some are covered with bumps, spines, ridges, or dents.

harlequin bug eggs

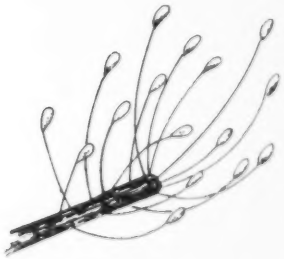


copper butterfly egg

preying mantis egg case

cockroach egg case

Some insects lay their eggs in leaf tissue, in rotting wood, or underground. And a few lay their eggs in special egg cases. All of these protected places help keep the eggs safe from predators and wet and cold weather.



Lacewings lay their eggs at the tips of stiff stalks.

Mosquitoes lay their eggs in rafts that float on the surface of water.

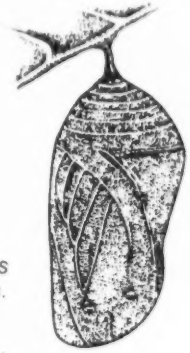
Photos by Harry Rogers

7. GROWING UP AN INSECT—PART I

About the Photos: This brightly striped caterpillar has been munching on milkweed leaves since it hatched from a tiny, ribbed egg (inset). One day it will stop eating, pupate inside a chrysalis (see illustration below), and emerge looking much like the striking orange-and-black monarch shown hanging from a milkweed leaf. This dramatic metamorphosis from egg to adult usually takes about three weeks.

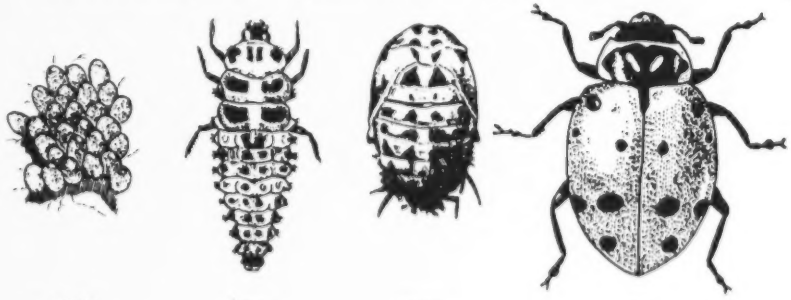
COMPLETE METAMORPHOSIS—A FOUR-STAGE LIFE CYCLE

Monarchs, like all butterflies, go through a four-stage life cycle: egg to larva to pupa to adult. This is called *complete metamorphosis*. Bees, wasps, ants, beetles, fleas, flies, and moths are examples of insects that also go through complete metamorphosis. The larvae of these insects look very different from the adults. For example, caterpillars (the larval stage of butterflies and moths) have chewing mouthparts, wormlike bodies, stumpy legs, and no wings or compound eyes. Butterflies, on the other hand, have siphoning mouthparts, slender legs and bodies, four wings, and two compound eyes.



Many butterflies pupate (change from a larva to an adult) in a chrysalis—*the hard outer covering of the pupa. This is a monarch butterfly chrysalis.*

Here are the stages in a ladybird beetle's life cycle:



eggs larva pupa adult

Photos by Mark Warner (butterfly), Rachel Lamoreux (egg), and Dwight R. Kuhn (caterpillar)

8. GROWING UP AN INSECT—PART II

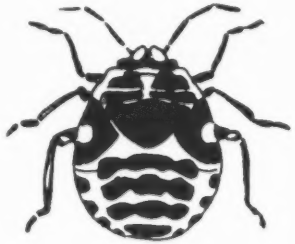
About the Photo: You won't find this colorful stink bug crawling around your neighborhood unless you live in the tropics. But you may find lots of its relatives, including other species of stink bugs, assassin bugs, ambush bugs, plant bugs, and water striders.

INCOMPLETE METAMORPHOSIS—A THREE-STAGE LIFE CYCLE

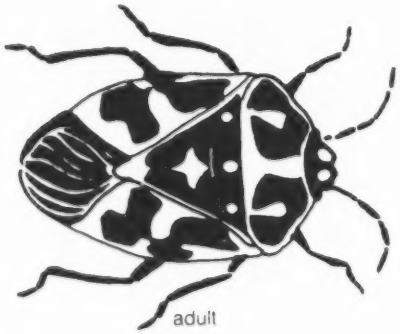
No matter where they live, all bugs go through a three-stage life cycle: egg to nymph to adult. So do cockroaches, mantises, termites, dragonflies, grasshoppers, and walkingsticks. This three-stage life cycle is called *incomplete metamorphosis*. Unlike larvae, nymphs usually look like miniature versions of their parents, although they don't have wings or fully developed sex organs. Nymphs molt several times as they grow. And by the final molt, the wings and sex organs have become fully developed. (The nymphs of some aquatic insects, such as dragonflies and stoneflies, don't look much like the adults. These nymphs are often called *naiads*. See photo card 10.)

Here are the stages in a harlequin bug's life cycle:

eggs



nymph



adult

Photo by Edward S. Ross

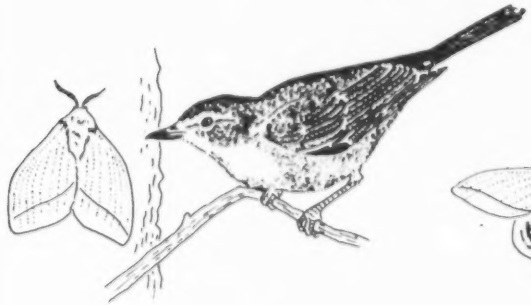
9. STAYING ALIVE

About the Photo: Some insects, like these tropical leaf butterflies, are tough to see—even when they're perched on a branch right in front of you. (Did you find all four?) These butterflies are *leaf mimics*. When their wings are closed, they look like dead leaves—a great way to hide from predators. Many other insects use a similar trick, mimicking twigs, bird droppings, stems, thorns, or other objects. There are also many non-poisonous insects that mimic poisonous ones, which fools predators into leaving them alone.

HIDE, RUN, FREEZE, SPRAY, SURPRISE, AND MORE!

Looking like something you're not is just one way insects keep from being eaten. Here are some other "tricks of the trade":

- Silverfish and cockroaches run away to escape danger.
- Some moths, grasshoppers, and other insects are the same color or pattern as their surroundings. They blend in so well that it's hard for predators to see them.
- Weevils and walkingsticks often freeze or play dead to avoid being eaten.
- Many insects defend themselves with chemical sprays (bombardier beetles), biting jaws (ants, tiger beetles), stingers (bees), poison (blister beetles), or other weapons.
- Some moths, butterflies, and caterpillars have huge eyespots on their wings or bodies to scare or confuse their enemies (see below).



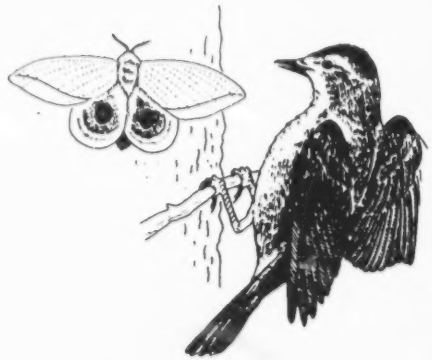


Photo by Alan Blank/Bruce Coleman, Inc.

10. INSECT LIFE IN THE WATER

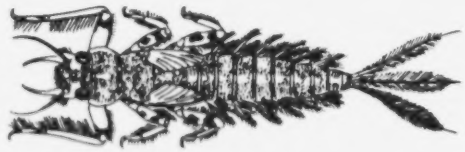
About the Photos: With lightning-quick speed, this dragonfly nymph shoots out its lower lip (inset). Tiny hooks at the end of its lip dig into a fish's flesh. Then the nymph whips its lip back and rips the fish apart with its jaws.

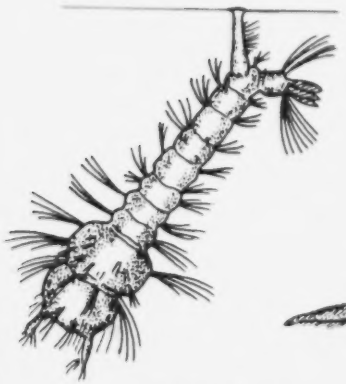
THE WET ONES

About five percent of all insects spend all or part of their lives in the water. Most of these insects live in freshwater ponds, lakes, streams, and rivers. But a few species live in oceans or saltwater marshes.

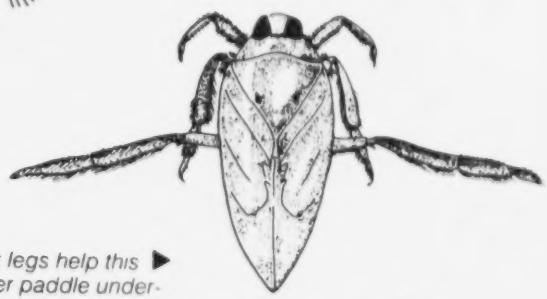
Adult mayflies, dragonflies, and stoneflies lay their eggs in or near water. The young, called *naiads*, spend their entire "youth" underwater, emerging when they become adults. Many flies, bugs, and beetles also spend all or part of their lives in or near water.

The feathery plumes along this mayfly nymph's abdomen are gills, which absorb oxygen from the water. ▶





◀ *Mosquito larvae use a breathing tube near the tip of their abdomen to get oxygen from the air.*



Oarlike back legs help this ▶ *backswimmer paddle underwater.*

Photos by Stephen Dalton/Oxford Scientific Films (dragonfly nymph) and Hans Pfletschinger/Peter Arnold, Inc. (inset)

11. INSECT-EATING INSECTS

About the Photo: It takes perfect timing and a little luck for a preying mantis to nab a quick-on-the-hop grasshopper. Mantises depend on surprise attacks, strong chewing mouthparts, and powerful grasping front legs to get a meal. And like many predatory insects, they feed mainly on other insects.

PREDATORS AND PARASITES

About one-half of all insects feed on plants. About one-quarter are scavengers that feed on decaying plant and animal material. And the rest are predators or parasites that feed on other animals. (*Parasites* are animals that live in or on the bodies of other animals and harm their hosts in some way.) Although some predatory insects feed on birds, mammals, reptiles, and other animals, most depend on other insects for the bulk of their diet.

Robber flies nab bees, beetles, and other insects, then suck out their body juices.

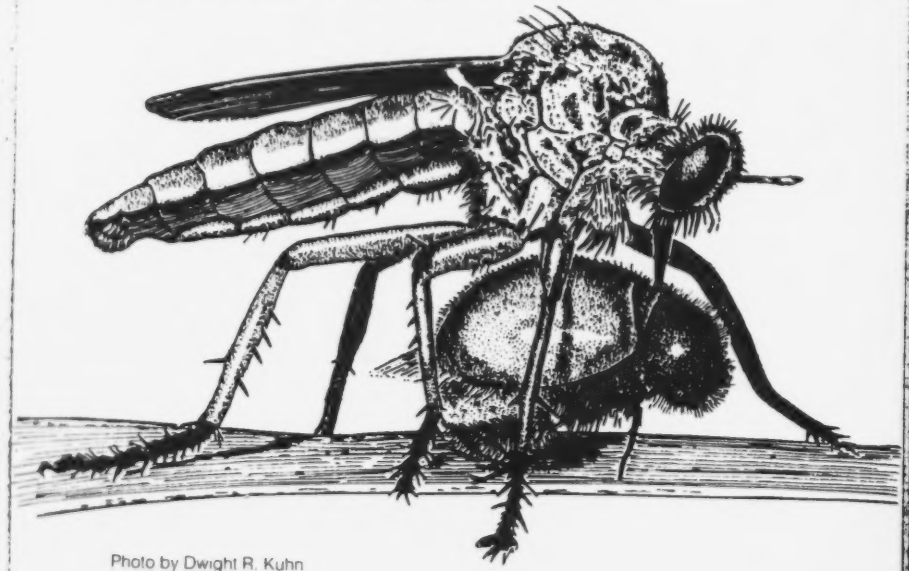


Photo by Dwight R. Kuhn

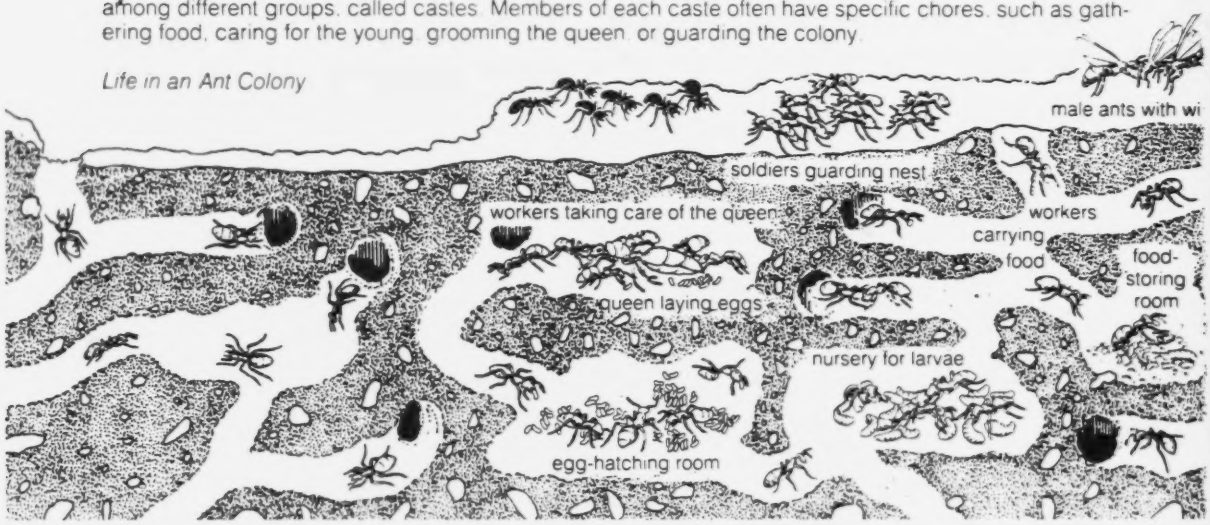
12. THE SOCIAL INSECTS

About the Photo: This honey bee worker is busy gathering protein-rich pollen and sugary nectar to take back to her hive. She stuffs the pollen into special baskets made of long hairs on her hind legs. And she uses her mouth to lap up nectar, then stores it in a special honey stomach inside her body. Like other social insects, this worker lives in a colony with others of her kind.

ONE BIG HAPPY FAMILY

Most insects live by themselves and meet other members of the same species only during the mating season. But social insects, such as some bees, ants, wasps, and termites, live together in communities headed by a queen. Most social insects have a *caste* system, in which the work for the colony is divided among different groups, called castes. Members of each caste often have specific chores, such as gathering food, caring for the young, grooming the queen, or guarding the colony.

Life in an Ant Colony



13. PESTS, PESTS, PESTS

About the Photos: It doesn't take long for a female mosquito to make a meal of your blood. First she stabs you with her spearlike sucking mouthparts. Then she squirts saliva into your wound and starts sucking up your blood. (The saliva thins your blood so it flows smoothly into her gut.) Finally, when her stomach is full, she flies away—just about the time that the wound starts to itch. And it all happens in less than a minute!

THE DIRTY DOZENS

Mosquitoes, house flies, assassin bugs, bed bugs, fleas, cockroaches, lice, and gnats are just a few of the dozens of insects that can make people miserable. But many insects are more than bothersome. Some spread diseases to people and other animals and to plants; many feed on crops; and a few eat the wood in our houses. But despite the problems some insects cause, less than one percent of all insect species are pests.

Fleas can be dangerous pests. They can carry germs that cause typhus, plague, and other diseases.

Photos by Dwight R. Kuhn

14. NATURAL PEST CONTROLS

About the Photos: Eating aphids and other insects is a way of life for ladybird beetles. Both the larvae and the adults (inset) gobble up aphids and other insects as fast as they can. Encouraging ladybird beetles to live in your yard is a safe way to control pests. One ladybird beetle, for example, can eat over 500 aphids in a single season!

IPM—THE WAY TO GO

Integrated Pest Management or IPM is a management program that controls insect pests by using a variety of techniques. Some people rely mostly on pesticides and other chemical poisons to control insects. Many of these poisons harm other types of animals, and contaminate soil, ground water, surface water, and food sources. IPM creates a more efficient and safe way to manage harmful insects because it relies on many different strategies, including:

- planting mixed stands of trees or crops instead of planting large areas with just one type of plant
- removing eggs, larvae, cocoons, and adults from plants by hand
- using natural and synthetic pheromones to attract and trap or confuse pests
- regulating planting and harvesting to avoid those times when insects are most abundant and damaging
- releasing thousands of sterile males or females of a pest species, resulting in matings that won't produce offspring
- physically changing a habitat to get rid of pest-breeding and feeding areas
- using chemicals only when needed
- using natural predators and parasites

Toads and other insect-eating creatures help keep some insect pests under control.

Photos by Robert E. Pelham (larva) and Lois and George Cox (adult)

15. WE CAN'T LIVE WITHOUT THEM

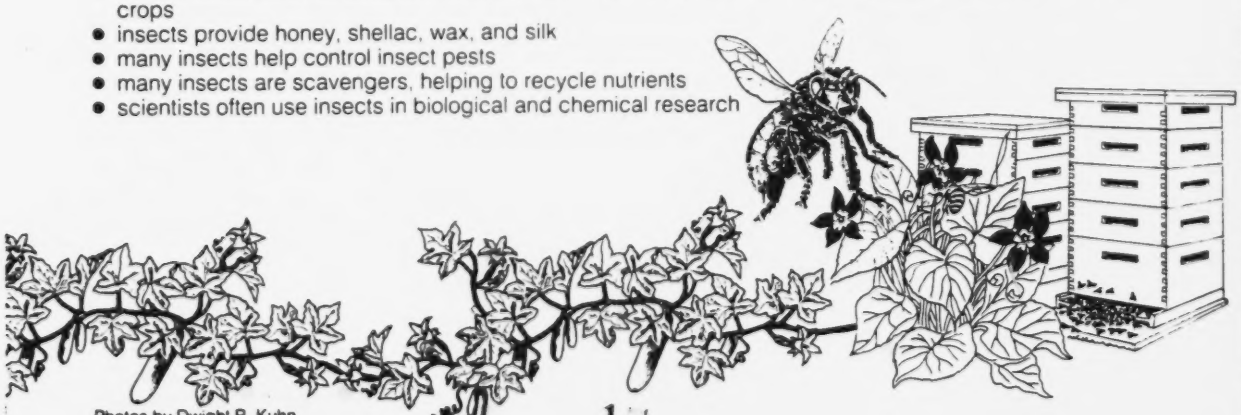
About the Photos: This Senegal chameleon is an expert insect-zapper. Its sticky-tipped tongue is as long as its body and can zip out in a flash to capture an unsuspecting insect on a nearby branch.

FITTING INTO THE FOOD WEB AND MORE

All kinds of animals, including many species of fish, amphibians, reptiles, birds, and mammals, feed on insects. For example, aquatic insects are a major food source for trout, bass, and other kinds of freshwater fish. And many birds, from woodpeckers to gnatcatchers, depend on a steady diet of insects. Even people are insect eaters. In some parts of the world, people eat cicadas, beetle grubs, grasshoppers, and other protein-rich insects.

But providing food for other animals is just one of the ways insects are important to other living things. Here are a few of the other "services" we get from insects:

- many insects, such as bees and flies, are very important plant pollinators, especially of fruit and other crops
- insects provide honey, shellac, wax, and silk
- many insects help control insect pests
- many insects are scavengers, helping to recycle nutrients
- scientists often use insects in biological and chemical research



Photos by Dwight R. Kuhn

A CLOSE-UP LOOK:

Your *Incredible Insects Discovery Pac* is designed to supplement your teaching in a variety of ways. Each *Discovery Pac* includes:

- a set of 15 full-color insect photo cards (see folder pocket, inside front cover)
- a collection of ready-to-copy *Ranger Rick* stories
- a variety of activities that relate to the stories and photo cards, emphasizing science, language arts, and social studies skills

The activities focus on both skills and content. And each one also includes a list of teaching objectives. The skills and objectives are highlighted in the left-hand margin for easy reference, along with the materials needed for each activity, the subject areas covered, and the recommended age groups. These age groups are:

- Primary (grades K-2)
- Intermediate (grades 3-5)
- Advanced (grades 6-7)

Please don't feel bound by the grade levels we suggest. You'll be able to adapt many of the activities to fit your particular age group and needs.

USING THE PAC WITH NATURESCOPE'S INCREDIBLE INSECTS

The stories, photo cards, and activities in this *Discovery Pac* complement many of the activities in *NatureScope—Incredible Insects* (Vol. 1, No. 1). Throughout the *Discovery Pac* we refer you to specific activities and resources in *NatureScope* that will give you more background information and activity ideas. We also suggest that you look through the *NatureScope* bibliography to find additional insect-related resources.

MAIN SCIENCE IDEAS

- Like all animal groups, insects have a combination of characteristics that makes them different from other animals.
- Most insects change as they grow through a process called metamorphosis.
- There are many different types of insects.
- Insects use a variety of senses to find food, escape from predators, find mates, and communicate.
- Insects are an important part of natural ecosystems.
- Many insects are beneficial to people and provide important services and products.
- Integrated pest management is an environmentally sound approach to controlling insect pests.

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1 Insect Discovery Stations

Photo Connection:
All photo cards

Objectives:
Describe several insect characteristics. Compare and contrast different types of insects.

Ages:
Primary, Intermediate, and Advanced

Materials:
- ***chalkboard or easel paper***
- ***copies of page 20 (primary only)***
- ***pencils and paper***
- ***index cards***

Subject:
Science

Skills:
Primary
- ***observing***
- ***comparing and contrasting***

Intermediate and Advanced
- ***observing***
- ***inferring***
- ***predicting***
- ***deducing***

Before you begin this activity, you'll need to set up the appropriate set of "insect stations" for your group. If you're setting up the stations for younger kids, put a photo card at each station and number the stations from one to fourteen. (Leave out photo card 2 for now.) For the older kids' version, copy the question listed under each station (see "Stations for Older Kids" on page 4) on an index card and place it at the station. Then follow the directions for the appropriate age group.

For Younger Kids:

1. Write the word "insect" on a chalkboard or sheet of easel paper. Then write down the names of some common insects, such as beetles, bees, butterflies, and cockroaches, and tell the kids that they are going to find out more about insects by going "station to station."

2. Have the kids walk around to each station. Tell them to look carefully at each of the pictures, then have them return to their seats.

3. Briefly discuss insect characteristics using the photo cards. For example, you could hold up photo card 8 and point out that adult insects have six legs. And you could show the kids photo card 6 to explain that insects lay eggs.

4. Pass out copies of page 20. Explain to the kids that they will be going to each station again, but this time they'll be looking for the insect features and other insect-related items pictured or listed on their Copycat Page. In the blank next to each picture, word, or phrase, they should write the number of the appropriate station. For example, next to the picture of the feathery antennae (A), the kids would write the number of the station featuring the luna moth. Go over each item on the Copycat Page with the group to make sure they understand what to look for. And tell them that some of the investigations may have more than one correct answer. (Before the kids start, add another station for the spider photo [photo card 2].)

5. Give the kids time to visit the stations and fill in the Copycat Page. Then discuss the answers. (See below. The number after each letter refers to the appropriate photo card.) During your discussion, use the information on the backs of the photo cards to talk about insect antennae, the differences between insects and spiders, camouflage, insect predators, and so on.

Answers to Copycat Page: A—4; B—3, 7, and 9; C—8; D—11; E—1 and 11; F—2; G—10; H—6 and 7; I—1, 3, 7, 9, and 14; J—9; K—2 and 11

For Older Kids:

1. Before the kids visit the stations, review some of the characteristics of insects, discussing terms such as *antennae* and *metamorphosis* (see the backs of the cards). You might also want to review the definition of *pollination* (the transfer of pollen by wind, insects, or some other agent from the male part of a flower [stamen] to the female part [pistil]).

2. Divide the group into pairs and give each person a piece of paper and a pencil. (You might want to make up a worksheet listing the investigations so that it's easier for the kids to keep track of their answers.)

3. Pick five of the pairs to be the first ones to go "station to station," and start each of them at a different station. Tell them that at each station they must first look carefully at each picture before coming up with an answer. Have them switch stations until each of the five pairs has been to all of the stations. Then pick another five pairs, and so on until all of the kids have been to all of the stations.

4. Have the pairs who aren't visiting stations write insect limericks, haikus, or other poetry when it's not their turn to visit the stations.

5. When all the pairs are finished, go over the answers (see page 5). As you go over each question or problem, use the photo cards to discuss insect characteristics, feeding methods, defense strategies, and so on.

6. As a follow-up, have each pair read their poem to the rest of the group.

tropical leaf insect

STATIONS FOR OLDER KIDS
(Tell the kids that after they have completed an investigation, they can read the information on the back of the card while waiting to switch stations.)

STATION #1
Photo cards 9 (labeled A) and 8 (labeled B)

There are four butterflies on card A—point out all four. What might be the advantage of these butterflies looking like leaves?

Now look at the stink bug on card B. Like many bugs, it smells and tastes terrible to predators. And its bright colors make it stand out against the green leaves in the tropical forest where it lives. What might its bright colors tell predators about the stink bug?

STATION #2
Photo card 4

Two scientists studying this male moth disagree on how it finds a mate. One scientist thinks that the male's large eyes help it find females. The other scientist thinks that the male's feathery antennae detect the odor of a female. Describe an experiment that could be used to help find out which scientist is correct.

STATION #3
Photo card 15

Describe two characteristics that

help this chameleon catch insects. Name some other animals that eat insects and describe some characteristics of each animal that help it catch its prey.

STATION #4

Photo cards 3 (labeled A), 11 (labeled B), and 13 (labeled C)

Describe what each of these insects is eating. Could these insects trade food with each other? Why or why not?

STATION #5

Photo cards 5 and 12

Read and think about this statement: *Honey bees are great plant pollinators*. Here is a list of honey bee characteristics. Some characteristics support this statement and others don't apply to it. On your paper, write the letters of the characteristics that you think support the statement. Also explain why you think each characteristic you chose supports the statement.

a. honey bees are brown and yellow
b. honey bees have branched hairs covering their bodies
c. honey bees can see special ultraviolet markings on flowers that guide them to the center of the flower
d. honey bees feed on nectar and pollen
e. honey bees have stingers
f. each honey bee tends to visit only certain species of flowers
g. most honey bees stay within a three-mile range of their hive
h. many honey bee hives have at least 50,000 bees
i. honey bees have two pairs of wings

Answers to station questions:

Station 1: Looking like leaves helps these tropical leaf butterflies hide from predators. And "wearing" bright colors warns predators that this tropical stink bug tastes terrible. Most animals leave this insect—and many other brightly colored animals—alone.

Station 2: Possible experiments could include placing the female in an opaque container covered with gauze in a room with air currents so that the male could smell but not see her and putting the female in a clear, airtight container so the male could see but not smell her.

Station 3: A long, sticky tongue flicks out to capture insects; skin color helps it blend in with its background; grasping toes help it hang onto branches. Examples of other insect-eating animals—bats (agile fliers, use echolocation); frogs (skin color helps them blend in, tongues flick out to catch insects); anteaters (strong, digging claws rip into termite colonies, long, sticky tongues slurp up insects); birds—flycatchers, kestrels, bluebirds (quick fliers, good eyesight).

Station 4: A—butterfly is feeding on nectar from a flower. B—preying mantis is feeding on a grasshopper. C—mosquito is feeding on blood from a person. These insects couldn't trade foods. The butterfly's siphoning mouthparts couldn't pierce skin. A female mosquito, which depends on the nutrients in blood to nourish her eggs, couldn't get the same nutrients from nectar. Neither a mosquito nor a butterfly has chewing mouthparts that could tear up insect prey. Finally, a preying mantis doesn't have the siphoning mouthparts needed to suck up nectar or blood.

Station 5: b—branched hairs pick up pollen and transfer it from flower to flower; c—ultraviolet markings guide the bees to pollen-producing parts of the plant; d—feeding on nectar and pollen facilitates pollination; f—by visiting only certain species of flowers, a bee is more likely to successfully fertilize a flower with pollen from a flower of the same species; g—by staying close to the hive, bees are more likely to pollinate flowers of the same species; h—the large number of bees in an area would increase the chance of fertilization.

Branching Out: More Photo Pac Activities

- Create a bulletin board using the insect photo cards. You might organize the cards by themes, such as growing up, super senses, staying alive, predators and prey, or finding food. Or you could make an insect habitats bulletin board and match the insects to the habitats where they live.
- Use the photo cards for creative writing activities. You could have the kids:
  - —write comical or informational captions
  - —imagine they are one of the insects pictured and write a short story about what life is like as that insect
  - —come up with a list of adjectives that describe each picture, then use the adjectives to write a poem or story

2
Moths vs Butterflies

StoryScope Connection:
"Pinky's Surprise" on page 26

Photo Connection:
Photo cards 3 and 4

Objective:
Describe some of the differences and similarities between moths and butterflies.

Ages:
Primary

Materials:
- ***copy of "Pinky's Surprise" on page 26***
- ***copies of page 21***
- ***crayons or markers***
- ***chalkboard or easel paper***
- ***live caterpillar and/or adult moth and butterfly (optional)***
- ***pictures of caterpillars (optional)***

Subjects:
Science and Language Arts

Thinking Skills:
- ***observing***
- ***comparing and contrasting***

Have your kids compare moths and butterflies and find out more about how these insects live.

1. Write the words *moth* and *butterfly* in large letters on a chalkboard or piece of easel paper and have the kids say each word as you point to it. Ask the kids to describe these insects and list some of the words they use. (They can talk about how these insects look or behave, where they live, and so on.) Leave the list up to use later.

2. Pass out copies of page 21. Also provide markers or crayons. Write the word *antennae* on the board. Explain that most insects have antennae and that an insect's antennae help it smell, taste, and feel. (You might also explain that the singular of antennae is antenna.) Have the kids look at the drawings on the Copycat Page of the two insects and tell them to point to the antennae on each insect.

3. Read "Pinky's Surprise" aloud to the group. (Before you start, tell the kids to be sure to listen carefully.) Afterward, work together to fill in the information on the Copycat Page. If possible, show the kids some live moths and butterflies. (You can catch several moths and butterflies before the kids arrive and then release the insects after the activity.)

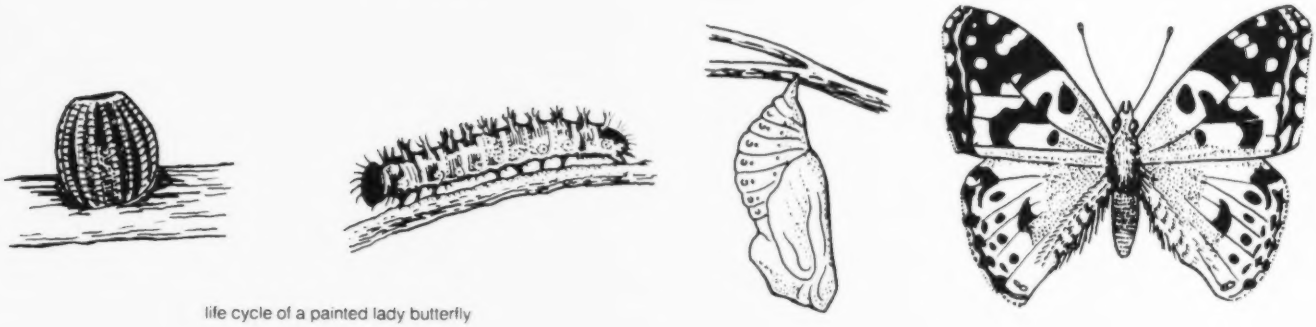
4. Go back to the list you made earlier and ask the kids if they would change any of their previous descriptions, based on what they found out by listening to the story and by watching the live butterflies and moths. You might also want to make two columns labeled "same" and "different" to list the similarities and differences between moths and butterflies.

5. Have the kids color the moth and butterfly on the Copycat Page. You can also have them draw pictures of the live moths and butterflies they observed.

Branching Out: Catch A Caterpillar

To find out more about butterfly and moth life cycles, take a hike to look for caterpillars. Before going outside, show the kids pictures of caterpillars and explain the four-stage life cycle of butterflies and moths (see photo card 7).

Answers to Copycat Page: Moth is on left. 1—M; 2—M; 3—B; 4—B; 5—M; 6—B. Both have two antennae, six legs, two pairs of wings, scales on their wings, and so on.



life cycle of a painted lady butterfly

3 Hoppin' Hoppers

StoryScope Connection:
"Hooray for Hoppers" on page 30

Photo Connection:
Photo card 1

Objectives:
Part I: Describe several characteristics of a grasshopper. Explain how to handle a grasshopper.
Part II: Write a question-and-answer story about an insect.

Ages:
Part I: Primary
Part II: Intermediate and Advanced

Materials:
Part I:
- ***pictures of grasshoppers***
- ***small, empty milk cartons***
- ***hand lenses***
- ***copy of "Down in the Meadow" on page 8***

Part II
- ***reference books***
- ***drawing paper***
- ***crayons or markers***
- ***copies of "Hooray for Hoppers" on page 30***

Subjects:
Language Arts and Science

Thinking Skills:
Part I:
- ***observing***

Part II
- ***evaluating***
- ***questioning***
- ***analyzing***

Part I: Down In The Meadow

By getting acquainted with grasshoppers, your kids can learn more about insects.

1. Show your group pictures of grasshoppers and point out the antennae, compound eyes, six legs (especially the long, strong hind legs), and three main body parts (see photo card 1). Ask the kids if they have any questions about grasshoppers and use "Hooray for Hoppers" on page 30 to help answer their questions.

2. Read aloud the short story called "Down in the Meadow" (see the end of this activity). Explain that when you get to certain parts in the story, the kids should repeat what you say. (The parts you emphasize are in italic type. The parts the children repeat are marked in bold.) As they say their part, they can slap their thighs and then clap, keeping rhythm with the chant. And when you read the story, say the part in italics to fit the rhythm.

3. After reading the story, ask the kids what they thought about the way Wanda treated Legs. Then talk about how to handle grasshoppers and other insects. Explain that it's OK to catch insects to take a closer look, but it's important to be gentle because their legs, antennae, and wings can be broken off easily. Also explain that it's not easy to keep an insect as a pet. Insects, like all wild animals, need certain types of food and conditions (the right temperature, amount of moisture, and so on) to stay alive. And it can be very difficult to provide those things at home. (You should also mention that some insects sting and bite and that they should be handled carefully.)

4. Divide the group into pairs and give each pair a small, empty milk carton and a hand lens. Then take the kids to a field or meadow and tell them to try to catch a grasshopper. (They can use their milk cartons or their hands to do the catching.)

Once they catch one, tell them to look at it closely, trying to see the characteristics you talked about at the beginning of the activity. You might want to catch one first, holding it firmly on both sides of the thorax, and point out the strong hopping legs (have the kids touch the hind legs from behind to feel the grasshopper push), the chewing mouthparts (hold a piece of grass to its mouth to see if it will give you a "chewing demonstration"), the antennae, and the large compound eyes. You can also carefully lift the wings and show the kids that grasshoppers, like most insects, have two pairs of wings. And, if you're lucky, the grasshopper may "spit" on you. Explain to the kids that this is one way the grasshopper protects itself. The brown stuff it spits out (which some people call "tobacco") doesn't taste good to would-be predators.

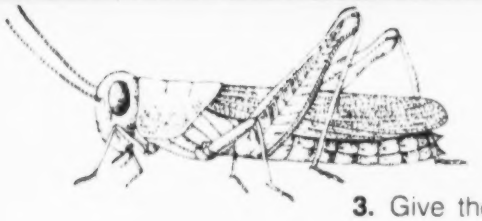
Part II: Questions and Answers

Writing an article in a question-and-answer format is a good way to squeeze in a lot of information. It's also a good way to help organize an article.

1. Pass out copies of page 30 and have the kids read "Hooray for Hoppers." Discuss the article and ask the kids what they liked and didn't like about it.

2. Have each person choose an insect he or she would like to learn more about. But before they do any research, have the kids make a list of things they would like to know about their insect. Then have them make up questions that would provide the information they wanted to know.

(continued next page)



3. Give the group research time and have them write an insect article in a question-and-answer format.

4. Have each person illustrate his or her article, then bind the articles together to make a class booklet about insects.

Down in the Meadow

Legs was a big, green-and-yellow grasshopper. He lived *down in the meadow where the grasshoppers hop.* **(down in the meadow where the grasshoppers hop)** One day, as Legs was munching on a juicy blade of grass, he heard a strange noise. The thing that was making the noise was somewhere nearby, *right in the meadow where the grasshoppers hop.* **(right in the meadow where the grasshoppers hop)** The noise got louder and louder. It was Wanda, a little girl who lived *up in a townhouse on the main city street.* **(up in a townhouse on the main city street)** Wanda was taking a walk in the meadow. And as she walked, the grass and weeds crunched under her feet. Just as Legs was about to hop away, Wanda reached down and grabbed him. She grabbed so carelessly that poor Legs almost lost one of his long, hopping hind legs. But luckily he didn't.

Wanda looked at Legs and said, "I'm going to take you home with me, Mr. Hopper." And she put him in her pocket and carried him *out of the meadow where the grasshoppers hop.* **(out of the meadow where the grasshoppers hop)** Then she *walked through the woods where the tall trees grow.* **(walked through the woods where the tall trees grow)** Legs was jostled this way and that as Wanda walked. He scrambled around in Wanda's pocket, but he couldn't find his way out.

Soon Wanda and Legs *came to the townhouse on the main city street.* **(came to the townhouse on the main city street)** Wanda went inside and took Legs *down to the basement where the spiders crawl.* **(down to the basement where the spiders crawl)** Then she took off her jacket and draped it over a chair. She peeked into her jacket pocket at Legs, who was crammed into a corner. "You stay right here, Mr. Hopper," she said. "I'm going to make you a nice place to live." And then she went off to find a jar to put him in.

Well, Legs didn't wait for Wanda to get back. He climbed and crawled and wiggled his way out of Wanda's pocket. Finally he was free! He took a flying leap into the air and landed in a dark corner, right in front of a big spider in its web. Legs would have made a nice meal for the spider. But Legs hopped away quickly and headed for the back door. He squeezed through a crack—and finally he was outside!

As fast as he could, Legs hopped *away from the townhouse on the main city street.* **(away from the townhouse on the main city street)** And he *hopped past a pond where the bullfrogs croak.* **(hopped past a pond where the bullfrogs croak)** And he just happened to end up in a place that looked a lot like the place where he had always lived—*down in a meadow where the grasshoppers hop.* **(down in a meadow where the grasshoppers hop)** Legs hopped onto a blade of grass and started munching. And he never saw Wanda again.

4 Short and Sweet

StoryScope Connection "Bugs, Bugs, Bugs" on page 27

Photo Connection: Photo card 8

Objectives:
Summarize the information in the article "Bugs, Bugs, Bugs." List several characteristics of bugs.

Ages:
Intermediate and Advanced

Materials:
- ***copies of "Bugs, Bugs, Bugs" on page 27***
- ***copies of page 22***
- ***chalkboard or easel paper***
- ***live specimens of several types of bugs (optional)***
- ***reference books (optional)***

Subjects:
Science and Language Arts

Thinking Skills:
- ***observing***
- ***classifying***
- ***analyzing***
- ***sequencing***

Here's a good way to have your kids analyze the information in an article and practice writing summaries.

1. Ask the kids what they think the word *bug* means. Then ask them to think about some of the characteristics of a bug, based on what they know or have heard. (List these on a chalkboard or piece of easel paper.)

2. Pass out copies of "Bugs, Bugs, Bugs" on page 27 and have the kids read it.

3. Pass out copies of page 22 and have the kids work in pairs to answer the questions. Discuss the answers as a group (see below).

4. Ask the kids why the author might have decided to have a bug tell the story. (make it more entertaining, make the story livelier, and so on) Ask the kids if they see any drawbacks to using a bug as narrator.

5. Go through the list of bug characteristics you made earlier and ask the kids which of the characteristics still fit. (If possible, have the kids observe some live bugs to see some of these characteristics up close.)

6. Ask if anyone can define the word *summary*. Explain that a summary is a short description of the main points of something—an article, a story, a conversation. Discuss the importance of summarizing information, both as a tool for understanding ideas and as a way to let others quickly know the main points of something. (If possible, read the kids an abstract of a well-known story to give them a better idea of what a summary is all about.)

7. Divide the kids into groups of three and have each group make a list of the main facts in the article. Explain that they will have to work together and discuss the article to come up with a list they all agree on.

8. Ask the kids if the facts they listed are accurate. How do they know? What are some ways they could find out? (check the information against other reliable sources, observe live bugs to see if the characteristics match, and so on) Then explain that the information in the article *is* accurate. (The only parts that are not true are the parts about bugs having opinions or thinking like people.)

9. Have each person write a summary paragraph about the article using the fact list each group compiled. Explain that the first sentence in the summary is the most important because it should state what the article is about. The other sentences should fill in some of the most important facts.

10. Read some of the kids' summaries out loud and compare what different people thought were the most important parts of the article.

Branching Out: Write an Article

Have the kids write a fact-filled article about another type of insect using an insect narrator. For example, someone could choose a butterfly or moth narrator to describe metamorphosis. Or a cockroach narrator could talk about pest control.

Answers to Copycat Page: 1—D, has piercing-sucking mouthparts and its folded wings form an X, 2—bugs and butterflies hatch from eggs, butterflies have a four-stage life cycle, bugs have a three-stage life cycle, bug nymphs look like adult bugs, caterpillars don't look like adult butterflies, 3—some blend in with their surroundings, many taste and smell bad to would-be predators, 4—bugs have piercing-sucking mouthparts (see photo card 3), some prey on other animals, others suck up blood or plant juices, 5—all of them

5 Creating Captions

StoryScope Connection:
"The Bees and Me" on page 36

Photo Connection:
Photo cards 5 and 12

Objectives:
Describe how honey is made. Complete a picture-caption story summarizing "The Bees and Me."

Ages:
Intermediate and Advanced

Materials:
- ***copies of "The Bees and Me" on page 36***
- ***copies of page 23***
- ***pencils***
- ***scissors***
- ***large pieces of paper***
- ***glue or tape***
- ***markers or crayons***

Subjects:
Language Arts and Science

Thinking Skills:
- ***summarizing***
- ***sequencing***

Your group can learn more about honey bees and honey by reading about a family's first experience with beekeeping. The kids will also get a chance to practice their summarizing skills as they write captions for a picture story.

1. Pass out copies of "The Bees and Me" on page 36 and have the kids read the story of Jonathan Walley and his bees.

2. Discuss life in a honey bee hive, how honey bees make honey, and other honey bee natural history (see photo cards 5 and 12).

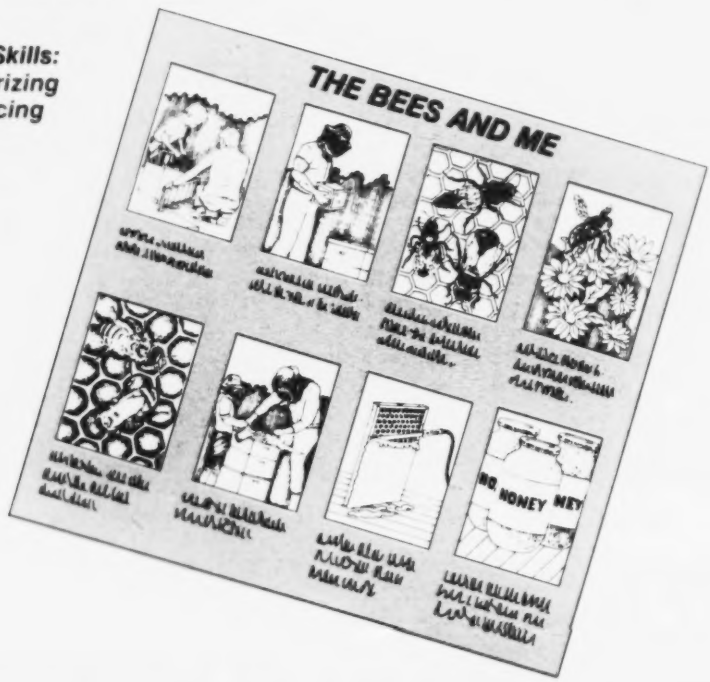
3. Pass out copies of page 23. Explain that the pictures correspond to some of the information that was in the article. Tell the kids that they will get to create a picture-caption story by picking out the main points of the story, sequencing the pictures, and writing short captions that summarize what's happening in each picture. (Stress that the captions should include complete sentences, not phrases.)

4. Before the kids begin, go over some of the basic rules of summarizing (see "Short and Sweet" on page 9). Explain that in a picture-caption story, it's very important to write lively, interesting captions. One way to do this is to use active, descriptive verbs as much as possible. Also explain that each caption should be concise—no more than two or three sentences long.

5. Have the kids cut out the pictures and arrange them in a way that they think best fits the story. (Explain that they don't have to use all the pictures, and that they can draw any other frames they feel they need.) Then have them glue or tape the frames onto a large piece of paper. (This will give them more room to write the captions.) Finally, have them write their captions underneath each frame (see illustration).

You might want to get younger groups started by listing some of the main events in the story or by discussing the pictures on the Copycat Page.

6. After the kids have finished, ask them how they decided on which information to include with each picture. Explain that by writing captions, they were emphasizing the main parts of the story and summarizing what they read.



Branching Out: Honey Tasters

After the kids finish their comic strips, hold a honey-tasting session. See "A Taste of Honey" on page 47 of *NatureScope: Incredible Insects* (Vol. 1, No. 1).

6 Science Fiction, Fantasy, and Fact

StoryScope Connection:
"Voyage to Hexatron" on page 38

Photo Connection:
All the photo cards

Objectives:
Describe some of the ways people differentiate between science fiction and fantasy. Create a fantasy or science fiction story using an insect theme.

Ages:
Intermediate and Advanced

Materials:
- ***reference books***
- ***copies of "Voyage to Hexatron" on page 38***
- ***chalkboard or easel paper***
- ***paper and pencils***
- ***drawing paper (optional)***
- ***crayons or markers (optional)***
- ***copies of "Shrinking Simon" on page 13 (optional)***

Subjects:
Language Arts, Social Studies, and Science

Thinking Skills:
- ***imagining/creating***
- ***inferring***
- ***sequencing***
- ***evaluating***

In this activity your group can compare fantasy and science fiction and discuss how both types of literature can incorporate scientific fact to make entertaining and thought-provoking reading. They can also use their imaginations to write their own sci-fi or fantasy stories.

1. Write the words *science fiction* and *fantasy* on a chalkboard or piece of easel paper and ask the kids to think of stories or books they've read that fall into one or both of the categories. Then ask someone to explain the difference between these two types of literature. (See box on next page.) Also ask the kids to think about what makes each one special and why an author might choose to write a science fiction or fantasy story. (Science fiction and fantasy stretch the reader's imagination and are sometimes used to comment on society in unusual, exciting, and thought-provoking ways.)

2. Pass out copies of "Voyage to Hexatron" on page 38 and have the kids read it. Afterward ask the kids if the story was fantasy or science fiction and why. (It's an example of fantasy because dragonflies will never be able to fly through space, insects will never be able to talk, and so on) Then discuss the story, using these discussion points as guidelines:

- What points was the author trying to make? (most insects are not pests; we depend on insects for many services and products; JJ was generalizing, based on limited information; and so on)
- Was fantasy an interesting way to present these points? Why or why not?
- What parts of the story, if any, are true? (Although there are many insect pests, people depend on insects in many ways. The information about honey bees and carrion beetles is also correct.)

3. Tell the kids they can write their own insect science fiction or fantasy stories. Pass around the insect cards to give the kids some ideas. Explain that their stories should reveal some observations or facts about insects. And they will probably have to do some research about their topic before they begin to write. Here are some title suggestions:
- The Day Insects Could Talk
- The Magic Cocoon
- The Day the Insects Took Over TV
- I Was Held Prisoner in an Ant Colony
- The Caterpillar That Couldn't Stop Growing
- I Was a Dinosaur Parasite
- How the Insects Saved the World

4. Review these story-writing steps with the kids:
- select the main idea of the story
- research the topic
- briefly describe the characters and setting
- outline the sequence of events in the story
- write a rough draft, revise, and rewrite

5. Have the kids research and write their stories. They can also illustrate the most exciting parts.

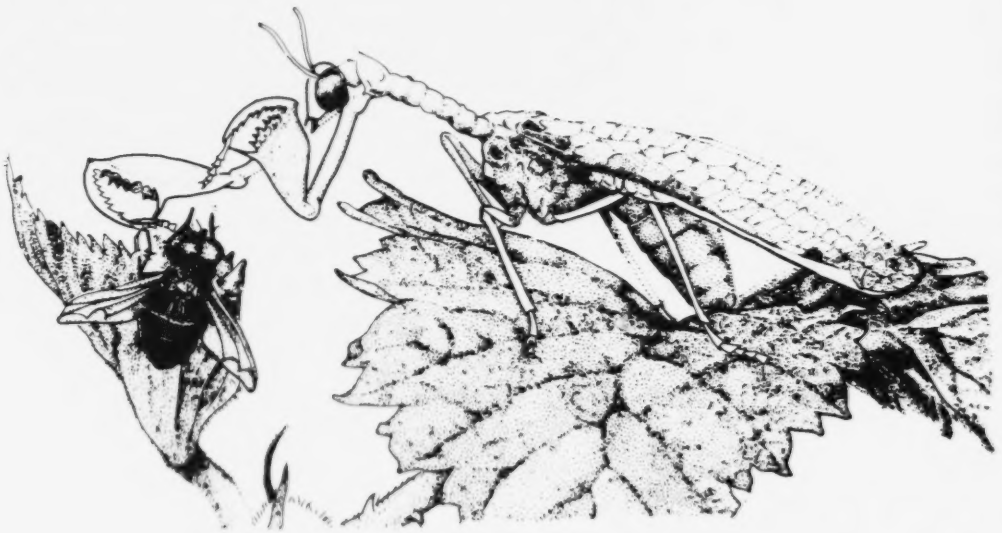
6. As an alternative or preliminary assignment to writing original stories, you can have the kids finish the story on page 13. (For younger groups, discuss some of the interesting events that might happen to Simon after he shrinks.) Afterward, have each person read his or her ending to the rest of the group.

(continued next page)

Fact-Based Fiction vs Magical Make-Believe

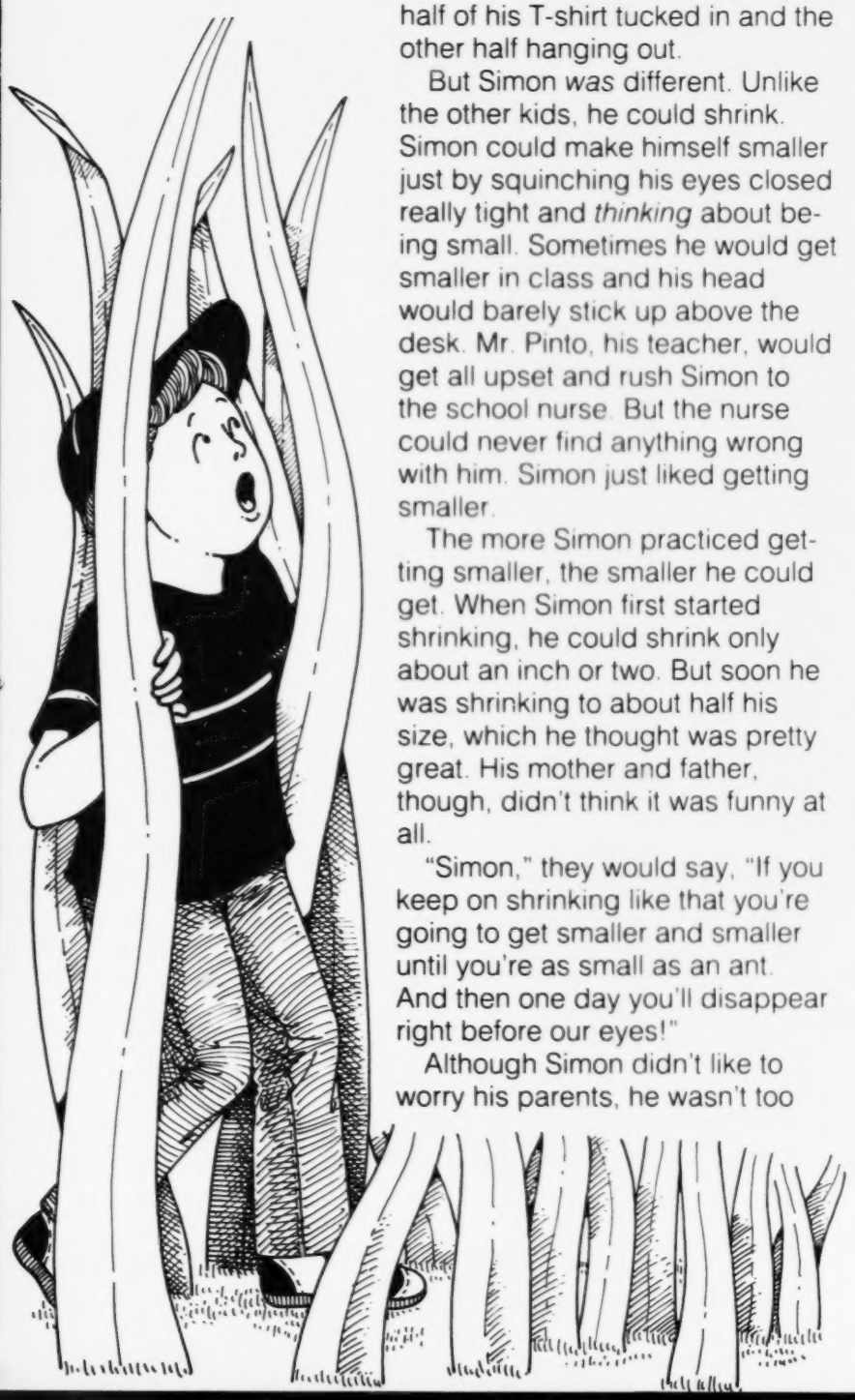
Fantasy and science fiction are two very popular types of literature. Although some people think that science fiction is a type of fantasy, many people differentiate between the two. "Real" science fiction, they say, is based on accepted scientific theories and is believable—even though it's fictional and often futuristic. (Science fiction makes readers feel that the events in the story could happen if new scientific discoveries were made.) Fantasy, on the other hand, is usually improbable and often is not based on what we know about how the world "works." Even though it can incorporate scientific fact, fantasy often relies on magic, talking animals, and other fantastical events that probably couldn't happen regardless of any scientific discoveries that might be made in the future.

Branching Out: Insects Pests and Helpers



Have the kids make a list of JJ's insect complaints. Then discuss the generalization JJ made about all insects being bad and ask the kids if they think the generalization is true. Point out that most insects are neither harmful nor helpful, but a few "stand out." Ask the kids if they can think of some examples of insect pests (cockroaches, silverfish, and so on) and insect "helpers" (honey bees, silk moths, and so on). Ask the kids to think of some other generalizations about insects and decide whether or not they are true. (See "The Anti-Insect Item Search" on page 16 for more about insect pests.)

SHRINKING SIMON AND THE VERY small MISTAKE



Simon wasn't an ordinary kid. But you probably wouldn't know that just by looking at him. Walking down the sidewalk, for example, Simon looked just like all the other kids. He usually slouched, instead of standing up straight like his parents did. And he usually had half of his T-shirt tucked in and the other half hanging out.

But Simon *was* different. Unlike the other kids, he could shrink. Simon could make himself smaller just by squinching his eyes closed really tight and *thinking* about being small. Sometimes he would get smaller in class and his head would barely stick up above the desk. Mr. Pinto, his teacher, would get all upset and rush Simon to the school nurse. But the nurse could never find anything wrong with him. Simon just liked getting smaller.

The more Simon practiced getting smaller, the smaller he could get. When Simon first started shrinking, he could shrink only about an inch or two. But soon he was shrinking to about half his size, which he thought was pretty great. His mother and father, though, didn't think it was funny at all.

"Simon," they would say, "If you keep on shrinking like that you're going to get smaller and smaller until you're as small as an ant. And then one day you'll disappear right before our eyes!"

Although Simon didn't like to worry his parents, he wasn't too concerned about shrinking. At least, he wasn't until the day when he made a very small mistake.

On that day, Simon was out playing baseball. It was very hot, and Simon had been standing in the outfield for what seemed like hours. A ball hadn't come his way in four innings. As the sweat trickled down his neck, Simon wondered if he could shrink down small enough to find some shade under a grass blade. He squeezed his eyes shut and thought about being small. *Really* small. So small that blades of grass would provide some cool, cool shade.

When Simon opened his eyes, he was staring right into the face of an enormous grasshopper. The grasshopper's eyes were bigger than Simon's head. And its jaws looked very sharp.

Simon started trembling and opened his eyes wide and thought BIG, BIG thoughts. But nothing happened. He tried again. Nothing.

Oh no, thought Simon. *This is it. My parents were right. I'm in big—oops—I mean* little *trouble.*

"Don't be frightened," the grasshopper said, as if grasshoppers had always been able to talk. "I don't eat people. I eat plants. Come on, let me show you my world." Since he didn't know what else to do, Simon climbed onto the grasshopper's back and they took off—hopping right over the foot of the girl playing center field.

Now you finish the story.

7 Focus on Fabre

StoryScope Connection:
"The Man Who Loved Insects" on page 32

Photo Connection:
All the photo cards

Objective:
Observe an insect and develop a hypothesis based on observation.

Ages:
Intermediate and Advanced

Materials:
- ***copies of "The Man Who Loved Insects" on page 32***
- ***clear containers for collecting and observing insects***
- ***paper and pencils***
- ***clipboards or cardboard and rubber bands (optional)***

Subjects:
Science and Language Arts

Thinking Skills:
- ***observing***
- ***hypothesizing***

Jean Henri Fabre, a famous French naturalist, devoted his life to observing nature and trying to understand why animals—especially insects—behave the way they do. In this activity the kids in your group will learn more about Fabre's work and have a chance to make their own discoveries by observing insects.

1. Make up worksheets for the kids with the following instructions on them:

1. Draw a picture of your insect.
2. Think about what you observed and form a hypothesis that starts out with "I think that . . . ."
3. Write down evidence you observed that may support your hypothesis.

2. Pass out copies of "The Man Who Loved Insects" on page 32 and have the kids read about Jean Henri Fabre.

3. Ask the group how Fabre made most of his discoveries. (by observing) Then write these three words on the board: *hypothesis*, *predict*, and *test*. Explain that scientific discoveries are usually based on observation and experimentation. Scientists first make a hypothesis based on what they have observed. From a hypothesis they may predict something that will happen, such as how an insect will behave in a certain situation. Then they test the hypothesis through experimentation to see if it "holds up."

4. Help the kids learn more about the process of forming and testing hypotheses by discussing some of Fabre's experiments. For example, ask the kids to think about the process Fabre used to discover how male moths found the female moth he had inside his house. To find out how the males found the female, Fabre formed several hypotheses and tested each one. First, for example, he thought that the males might have been attracted to the female by sight and might have seen her when they flew by the window. He predicted that if he hid the female, the males would not find her. His prediction didn't hold up. The males still flew in and found her.

Next he suggested that the males might have been attracted to her odor. He predicted that a very strong-smelling substance in the room would mask her scent. But again, the males still located her. Despite the results of this experiment, Fabre was still convinced that the moths' sense of smell was the important factor. So he tried another experiment. He cut off the males' large antennae (so they couldn't smell anything), and he held the female captive in a jar. The males couldn't locate the female and Fabre was able to conclude that his hypothesis (that female moths release a scent that attracts males and that males use their antennae to smell it) was correct.

5. Divide the group into pairs and pass out pencils, clipboards, copies of the worksheet you made up earlier, and containers for catching insects. (If you don't have clipboards, have the kids attach paper to cardboard with rubber bands.)

6. Take the kids outside and have each pair find an insect to observe. The kids can observe grasshoppers, ants, beetles, or any other insect they can find within the boundaries you set. And they can either watch the insects at the site or collect the insects and observe them in a container.

Safety Note: Tell the kids to use their containers, not their hands, when collecting insects, since some insects can inflict painful bites. And they should not try to collect insects that sting, such as honey bees and wasps.

Have the kids watch their insect closely for about ten minutes. They should write down all the behaviors they observe on the back of their sheet, and also record information such as the insect's shape, color, and size.

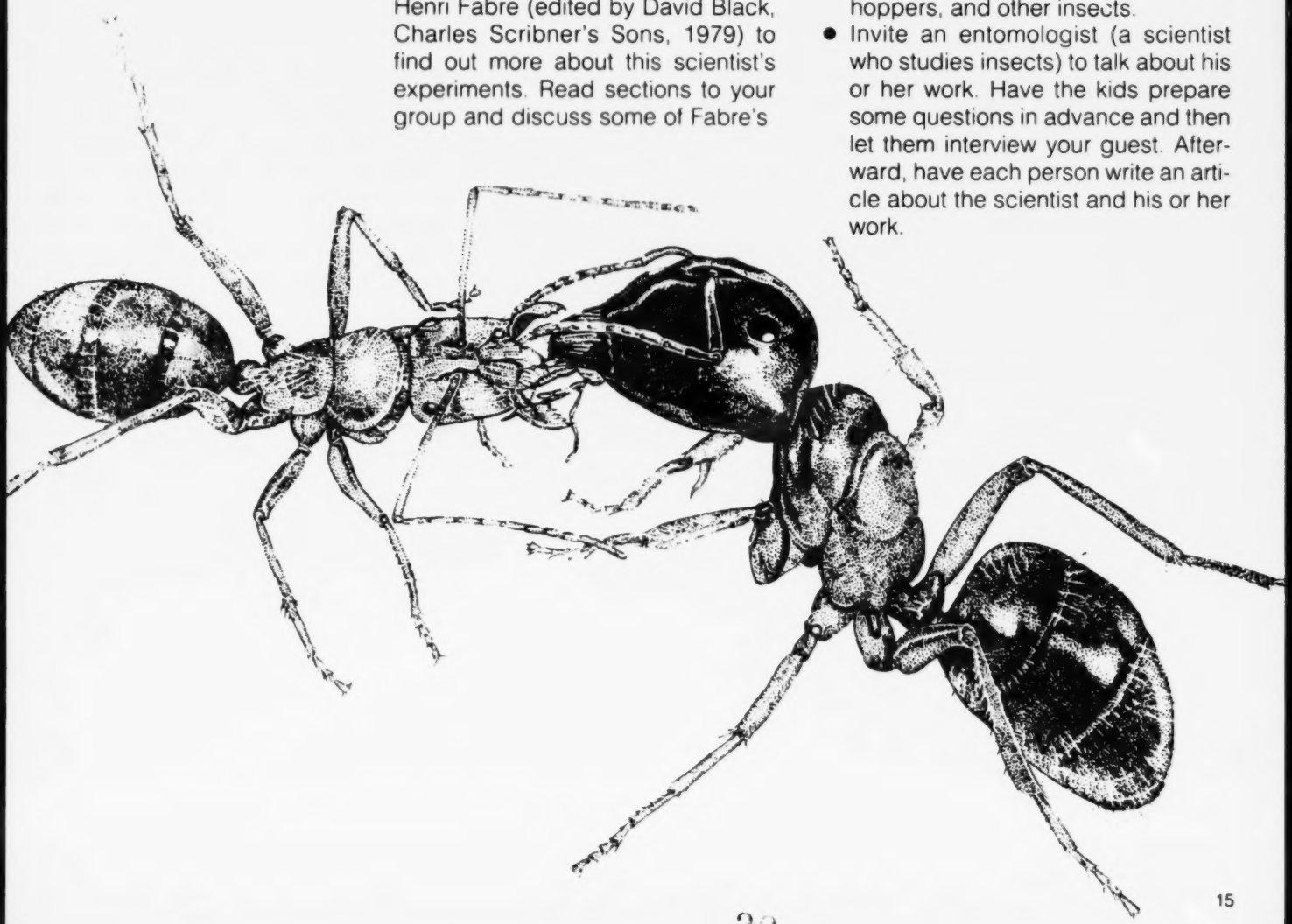
7. At the end of the observation period, have the kids fill out their sheets. After drawing their creature, have them think of a hypothesis based on the observations they made. Explain that their hypotheses should start with "I think that . . . ." Tell them to also write any evidence they observed that supports their hypothesis. For example, they might say "I think that ants prefer foods that are sweet." And the evidence might be the kids' observation that a group of ants were feeding on a candy bar.

8. Discuss each pair's hypothesis and talk about ways they might test each one. Give each pair time to test their hypothesis to see if the test supports their prediction.

Explain that scientists repeat an experiment many times before they reach any conclusions. Also point out that scientists observe for long periods of time and that they often have to rethink and repeat their experiments, changing their hypothesis as they collect new data.

Branching Out: Finding Out More

- Check out the book *Insects* by Jean Henri Fabre (edited by David Black, Charles Scribner's Sons, 1979) to find out more about this scientist's experiments. Read sections to your group and discuss some of Fabre's work with spiders, cicadas, grasshoppers, and other insects.
- Invite an entomologist (a scientist who studies insects) to talk about his or her work. Have the kids prepare some questions in advance and then let them interview your guest. Afterward, have each person write an article about the scientist and his or her work.



8 The Anti-Insect Item Search

StoryScope Connection:
"Voyage to Hexatron" on page 38

Photo Connection:
Photo card 14

Objective:
Describe several ways people control insect pests.

Ages:
Intermediate and Advanced (primary with direction)

Materials:
- ***copies of "Voyage to Hexatron" on page 38***
- ***copies of page 24***

Subjects:
Social Studies, Language Arts, Math, and Science

Thinking Skills:
- ***observing***
- ***graphing***
- ***interpreting data***

An Investigation for Kids and Their Parents

Your group can learn more about how people control insect pests by doing some investigative work with their parents.

1. Pass out copies of "Voyage to Hexatron" on page 38 and have the kids read the story about JJ's visit to the planet of the insects. (You might want to read it aloud to younger children.)

2. Have the kids list the complaints JJ had about insects. Encourage the group to think of other ways insects cause troubles for people.

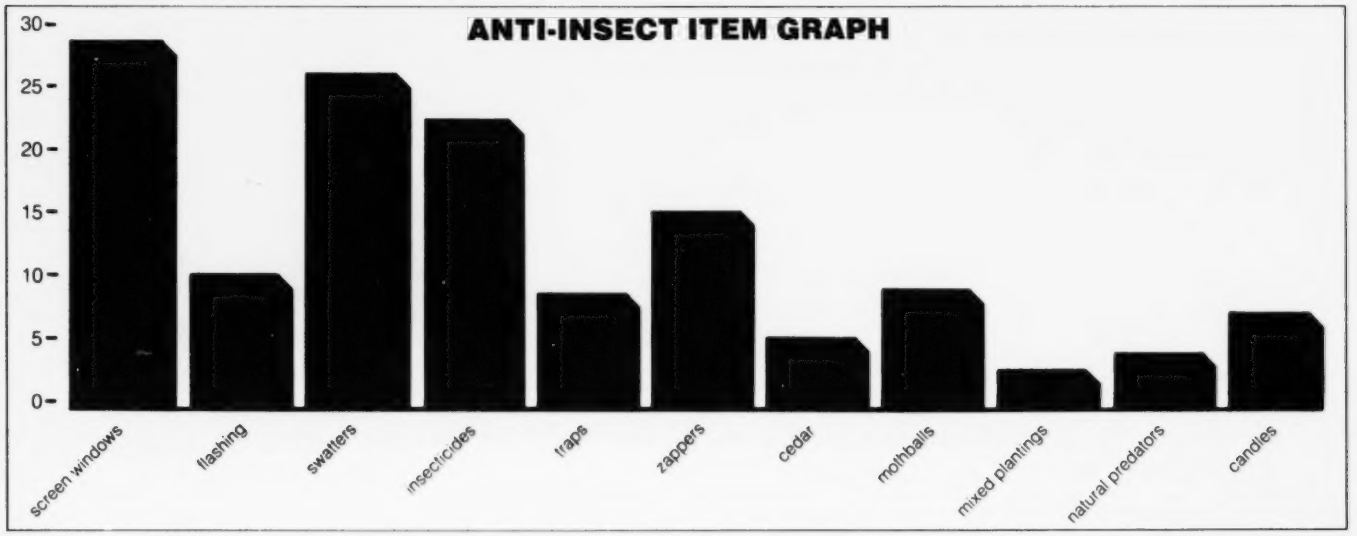
3. Ask the kids what JJ learned during his visit to Hexatron and make a list of some of the ways insects are beneficial to people. Explain that even though all insects are important ecologically, most do not directly affect people. And of the small percentage of insect species that *do* affect people, some are beneficial and others are pests. Also explain that it's important to control insect pests in ways that do the least amount of harm to the environment.

4. Pass out copies of page 24 and explain that each item on the page is one way people try to control insect pests. Discuss each item (see information under "Anti-Insect Items" on the next page).

5. Tell the kids to take their anti-insect sheets home and work with their parents to find out which of the items they have at home. Also tell them to add any items that their parents might own or use that aren't on the sheet. (Explain that they can use the last square on page 24 to draw in an "extra" item.)

6. The next day, tally the information by having the kids raise their hands to show how many had each item. Then have each person make a bar graph to record the information. Tell the kids to list the items from the sheet along the horizontal axis and number the vertical axis to allow for the number of kids in the group (see diagram).

7. Discuss the results and talk about safe insect pest control and integrated pest management using the information on the next page. (Also see photo card 14 and pages 45-46 in *NatureScope: Incredible Insects* [Vol. 1, No. 1] for more about integrated pest management.) You can also run off copies of page 17 for the kids to take home to their parents.



ANTI-INSECT ITEMS

The anti-insect items on the sheet fall into these three general categories:

Physical and Mechanical Controls are some of the safest ways to control insect pests because they aren't poisonous.

Physical and mechanical controls include:

- putting up window screens
- installing metal termite flashing and termite barriers, which help prevent termites from getting into the wood underneath and on the sides of houses
- using flyswatters
- planting marigolds and other pest-repellent plants throughout your garden
- picking pests off your garden plants by hand
- removing old tires and other items that often fill with water and become mosquito breeding grounds
- using sticky, non-poisonous tape
- putting up mosquito netting

Many entomologists think that "bug zappers" are not effective insect pest controls because they indiscriminately kill any insects that are attracted to lights, including predatory insects that eat insect pests.

Chemical Controls are considered the most risky form of pest control. Even though pesticides and other poisons are often the most effective controls in the short run, many insects quickly become resistant to them. And most insect poisons are deadly to many types of living things—not just insect pests. They also can contaminate the soil for many years, and they're difficult to dispose of safely.

Most entomologists agree that you should try other pest control methods first and use pesticides only as a last resort. And if you do use poisons, you should follow these safety procedures:

- use the least toxic pesticide that is available
- buy only as much as you'll need
- read the directions for proper use and disposal
- never apply when children and pets are nearby
- store out of reach of children and pets

Chemical controls include mothballs, aerosols, powdered and liquid insecticides, roach traps, insecticide-soaked pest strips, and other pest poisons.

Biological Controls include insect parasites, predators, or pathogens. Biological controls are safer than poisons because they don't harm other living things. Here are some examples of ways to use biological controls:

- encourage natural predators, such as bluebirds and purple martins, to nest in your yard
- release ladybird beetles, lacewing larvae, and other natural insect predators in your yard to help control aphids and other pests
- release parasites that will parasitize the pest you are trying to control
- use species-specific, natural pathogens to kill various pest species

For more information about integrated pest management, contact your local extension agent (usually in the phone book under local government).

9 The Pest Patrol

Photo Connection:
Photo card 14

Objectives:
Conduct a community project to educate people about how to safely control common insect pests. Research pest problems and investigate safe solutions.

Ages:
Intermediate and Advanced

Materials:
- ***chalkboard or easel paper***
- ***reference books***
- ***poster paper, writing paper, and other materials (optional)***

Subjects:
Social Studies, Science, and Language Arts

Thinking Skills:
- ***interpreting data***
- ***solving problems***
- ***evaluating***

A Community Investigation

In this activity, your kids can investigate insect pests in their community and help community residents learn more about safe pest controls. (To give your kids more background on insect pest control, have them complete "The Anti-Insect Item Search" on page 16 before starting this activity. And be sure to introduce the term *integrated pest management* [see photo card 14].)

1. Ask the kids to list some neighborhood insect pests. Explain that many people who have insect pests don't know that there are usually several ways to control them and that certain pest control methods are more dangerous or costly than others.

2. Ask the kids to think about some of the ways they could help community residents learn more about safe and effective ways to control insect pests. (You might want to divide the group into teams of three to brainstorm.)

3. Discuss all the suggestions and ask the group to decide which one would be most feasible for them to do (considering their time, the resources they have, and so on). After picking one of the options, divide the group into teams and have each team work out a plan of action. Tell the kids to keep these points in mind:
- what they want to accomplish
- what materials they will need
- how much time the project will take
- how many people will need to work on each step
- what other people in the community could do to help
- what types of research the group will need to do
- how they will evaluate their project

4. Hold another group discussion to combine the teams' ideas into one plan of action. Remind the kids that the goal is to help educate the community, as well as to educate themselves.

A Sample Community Project

1. As a group, have the kids design a questionnaire to find out what the most common insect pests are in their community and how people currently solve their pest problems. Here are some suggestions for questions that could be included on the questionnaire:

A. Which of these are common insect pests in your home, yard, or garden? (Circle all that apply.)
- termites
- clothes moths
- caterpillars (tent, gypsy, etc.)
- silverfish
- cockroaches
- fleas
- mosquitoes
- ants
- others (please list)_____

B. Are any of these insects more troublesome to you than the others? Which ones? What kinds of problems do they cause?

C. How do you usually control the pests you circled or mentioned in the first question?
D. Are you satisfied with the results? If not, why?
E. Are there other pest control practices you haven't tried, but would like to?

2. Divide the group into three-member teams and have each team distribute the questionnaire to several people in their community. They will probably get better results if they visit people directly, but let each team decide how it wants to gather the information. Also set a time limit for getting the information back.

3. Tally the information from all the teams and make a list of some of the most common insect pests in the community. Also make a list of some of the control methods people have used to get rid of these insect pests.

4. Ask each team to pick one of the common insect pests and find out more about it and some of the methods used to control it. Before the teams start their research, give them some guidelines. For example, they should find out about the insect's life history, evaluate pest control alternatives, and so on (see suggestions under #6).

5. Discuss resources in the area that the kids can use to find out more, including libraries, the extension service (usually in the phone book under local government), nature centers, beekeepers, entomologists at local universities, garden shops, pest control companies, and state departments of natural resources.

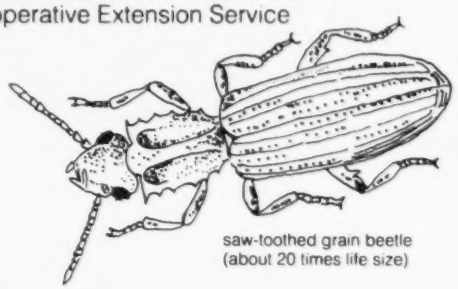
6. After the kids have completed their research, ask them to think of ways to get the information they've collected out to the people in the community. Give them time to think about this, then make a list of some of the community projects they could do, including writing and distributing pamphlets, making posters, and sponsoring an insect pest day in local libraries. For example, if they want to pass out pamphlets on specific pests, they could:

- describe the life cycle of each insect pest and include a picture of each stage
- describe the pest problem (how to know if this pest is in your house or garden, and so on)
- discuss alternatives to chemical pest control methods, describing the pros and cons of each method
- include a bibliography or resource list
- include a list of experts in the area that have agreed to help answer questions
- credit the people who helped with the project

Here's a sample insect pest and how it might be presented in a pamphlet:

ARE THERE BEETLES IN YOUR PANTRY?

PROBLEM—Tiny insects in your cupboards that eat flour and other grain products.
IDENTIFICATION—Many types of beetles and other insects get into grain. Take some of the insects to an entomologist at a local university or cooperative extension office to get an identification.
TREATMENT—Remove all items from pantry shelves and vacuum the area to get rid of the adult insects and eggs. Put all new grains into airtight containers made of hard plastic or glass. Don't use aerosol sprays or other insecticides in areas where you are either storing or preparing food.
PREVENTION—Check dry goods periodically for insects. Buy only limited quantities of dry goods.
SOURCE OF INFORMATION: Cooperative Extension Service



saw-toothed grain beetle
(about 20 times life size)

Copycat Page

Insect Discovery Stations

A. antennae shaped like

_____

B. antennae shaped like

_____

C. a body shaped like

_____

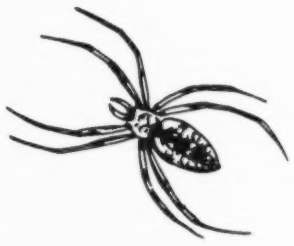
D. a head that looks like

_____

E. a leg that looks like

_____

F. a spider



_____

G. an animal that lives in water

_____

H. insect egg

_____

I. an animal with spots

_____

J. 4 butterflies in one picture

_____

K. something eating a grasshopper

_____

Copycat Page

Moths vs Butterflies

Draw a red circle around the moth.
Draw a blue circle around the butterfly.

Fill in the blanks.
*Write the letter **M** for moth.*
*Write the letter **B** for butterfly.*

1. *Has a plump body* _____
2. *Usually rests during the day* _____
3. *Holds its wings over its back* _____
4. *Has antennae shaped like this* _____
5. *Has antennae shaped like this* _____
6. *Eats during the day* _____

What are some ways butterflies and moths are the same?

_____

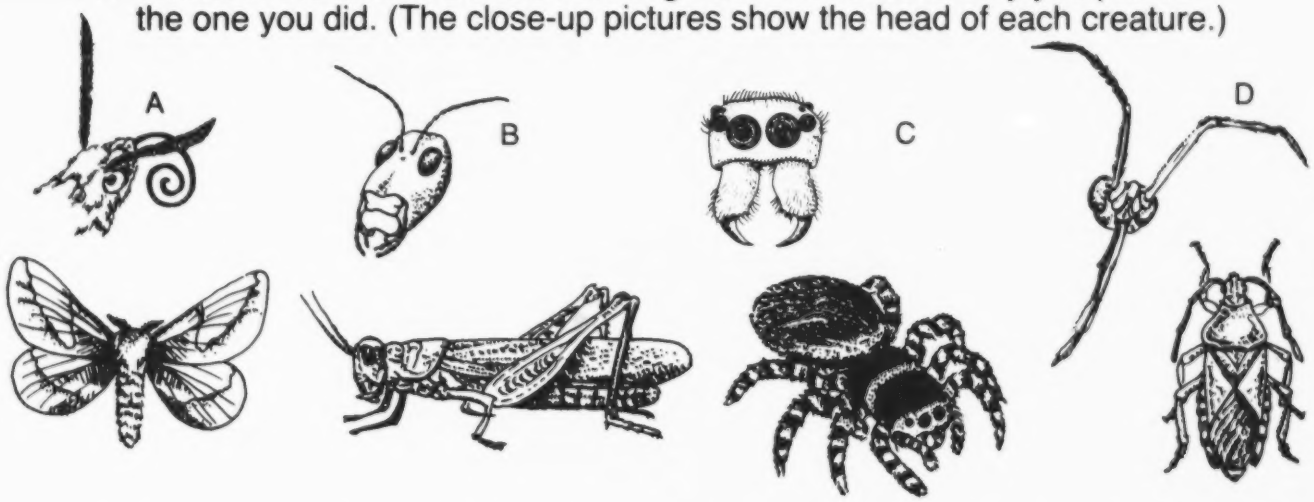
_____

_____

Copycat Page

Short and Sweet

1. Which of these animals is a real bug? List two reasons why you picked the one you did. (The close-up pictures show the head of each creature.)



2. This is the life cycle of a butterfly. How is it similar to the life cycle of a bug? How is it different?

3. What are some ways that bugs keep from being eaten? _____

_____

_____

4. Describe how a bug eats. Also list some bug foods. _____

_____

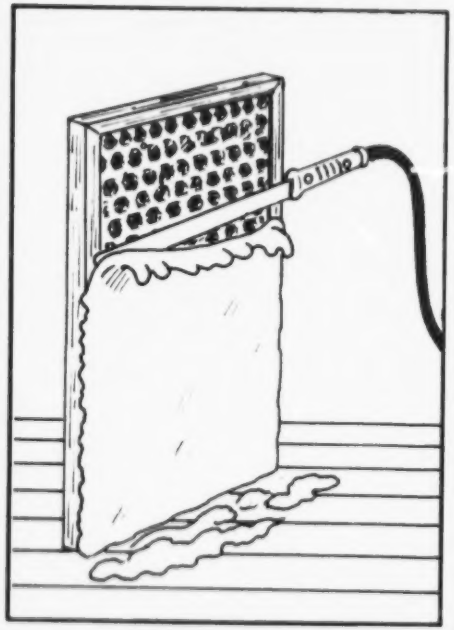
_____

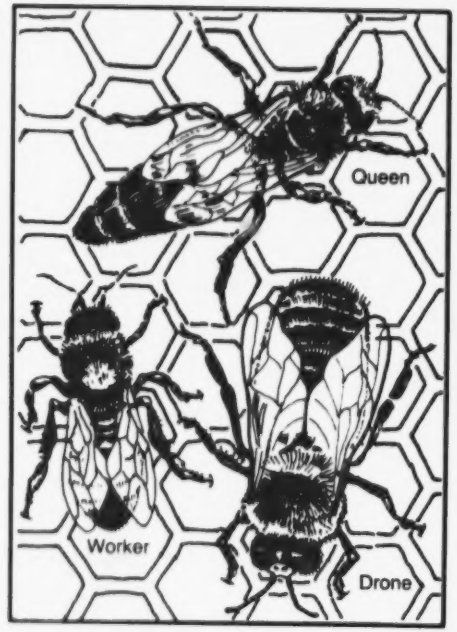
5. Circle the habitats in which you would expect to find bugs.

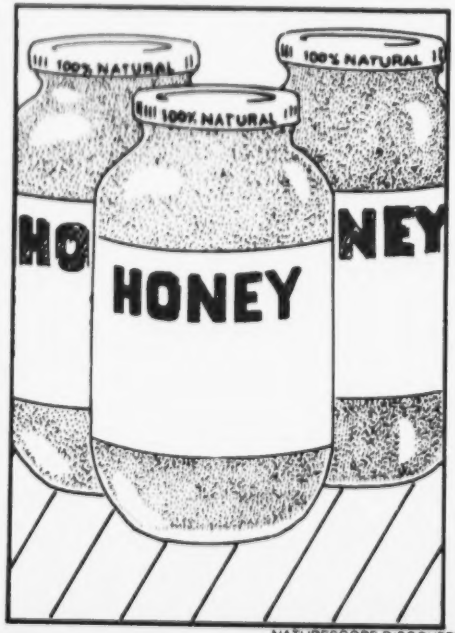
(See Short and Sweet—p 9)

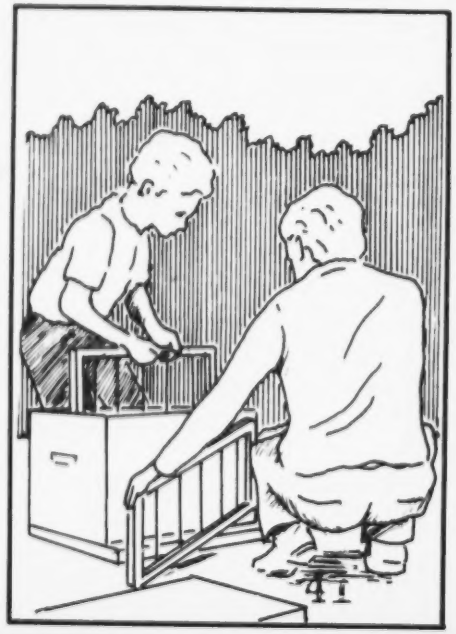
Copycat Page

Creating Captions









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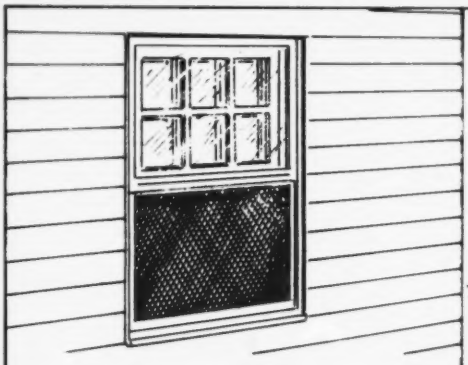
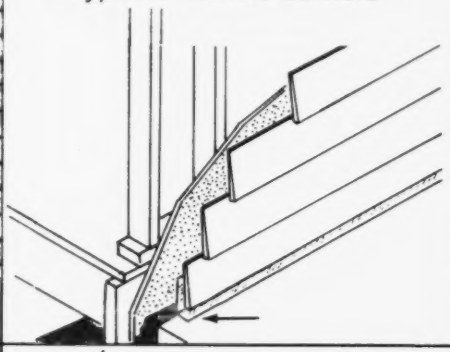
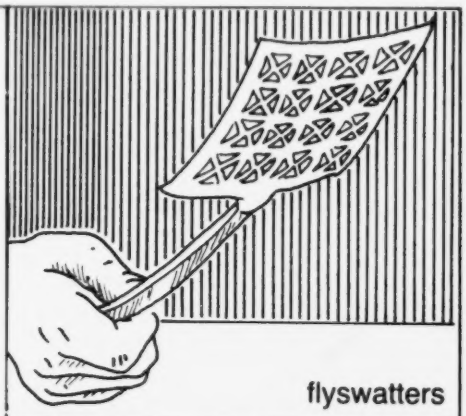
Anti-Insect Item Search



screen windows

metal termite flashing or other types of termite barriers





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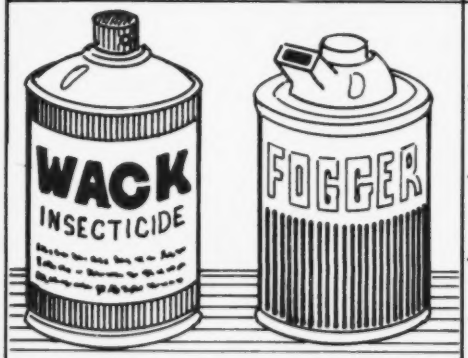
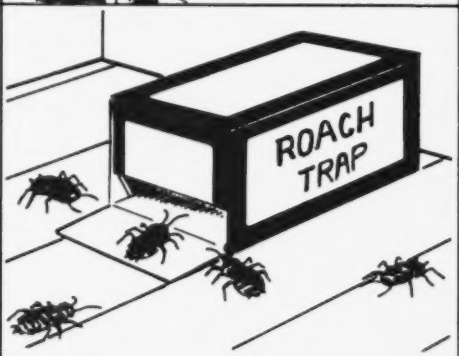


insecticide sprays and foggers



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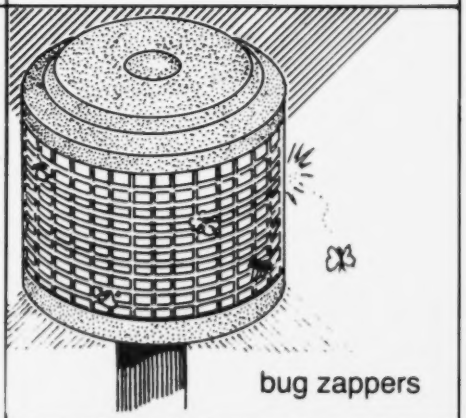
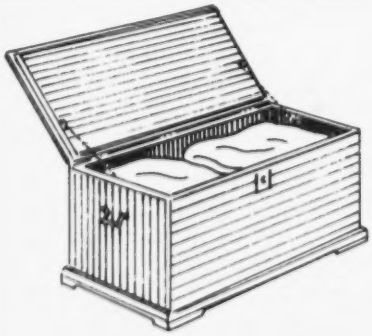
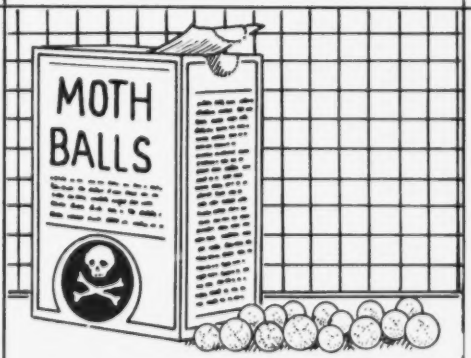


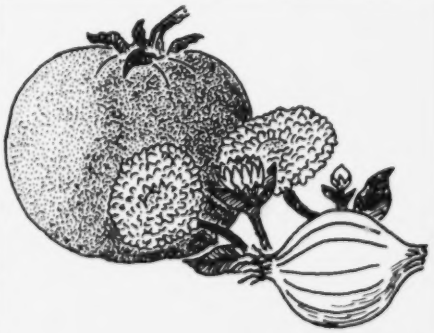
bug zappers



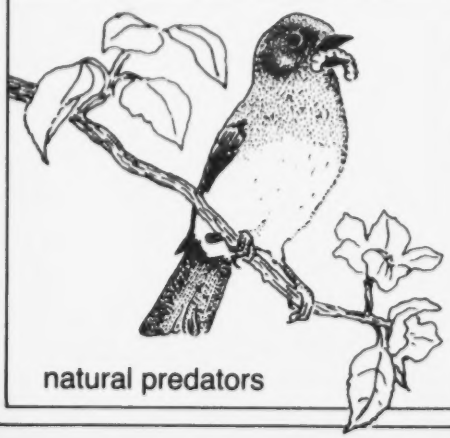
cedar chests or closets



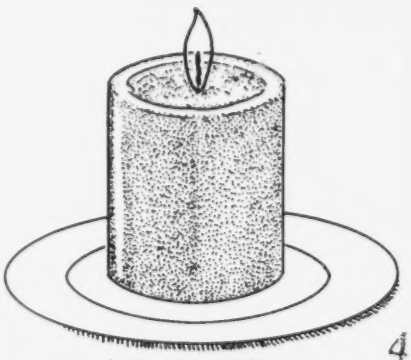
mothballs



mixed plantings in gardens



natural predators



insect candles

storyScope

Pinky's Surprise

by Janet Quin-Harkin

Everyone in the Kingdom of Oak Forest was excited. King Oak had announced that there was to be a big party for Princess Annabelle's birthday. "Everyone is invited," he said to all his subjects. "And I hope each of you will think of something to make my little daughter's birthday special."

The palace servants were very pleased. Most of them had good ideas for what they were going to do for the princess.

"I know what I'll do," said the cook. "I'll bake a cake so light and airy it will float right off the plate."

"I have a good idea," said the gardener. "I'll make the princess a beautiful crown of wild flowers."

"I'm going to ask the fireflies to put on a light show for her," said the maid.

"I will ask the nightingales to sing for her," said the footman.

"And I shall ask the west wind to whisper her a bedtime story," said the royal tutor.

Only Pinky, the smallest page boy, could not think of what to do.

"Oh dear, the others have taken all the good ideas," he said. "And King Oak will be disappointed if I don't think of something special to do for the princess."

He thought and thought all day as he did his chores. When he was through, he walked through the forest thinking and thinking. Finally the sky began to get dark. Pinky was crossing a small stream on his way home when suddenly he had a wonderful idea. He smiled a big smile.

"I remember the last time I went walking with Princess Annabelle by this stream. She loved watching the butterflies dancing over the water. I'll ask them to come to the party and dance for her!"

The next morning Pinky hurried to the spot where the butterflies danced.

"Will you come and dance for Princess Annabelle's birthday?" he asked.

"We shall be pleased and honored," said the butterflies. "Come and fetch us when the party is going to start. You will always find us here by the stream."

On the day of the party everyone worked hard, cooking and cleaning. The decorations in the king's garden made it look quite magical. As the sun set, the first guests began to arrive. Pinky picked up a lantern and hurried down to the stream. But no butterflies were there.

"Butterflies, where are you?" he called.

Silence, except for the rustle of leaves in the breeze.

"Butterflies, where are you?" he called louder.

"We're over here in this bush," answered a very sleepy voice. "What do you want?"

"The party for the princess!" cried Pinky. "It's about to start."

"Are you crazy?" said the sleepy voice. "You woke me up. All the other butterflies are *asleep*!"

"But you *promised*!" cried Pinky.

"You didn't tell us the party was going to be at night," said the butterfly. "We always sleep when it's dark. We can't come *now*!"

"But what am I going to *do*? The king will be very angry with me," said Pinky, and he started to cry.

"Don't cry," said the butterfly more kindly. "I have an idea. Why don't you ask our cousins, the moths, instead? They like to dance at night."

"But you look so much alike, how can I tell a moth from a butterfly?" wailed Pinky.

"That's easy," said the butterfly. "There are three ways: First—look at my wings. When I am resting I hold them together over my back, like so. But a moth folds its wings down against its body or holds them straight out to the sides.

"Second—look at my antennae. See how they have knobs on the ends? A moth has feathery antennae but usually no knobs at the ends.

"Third—look at my body. See how it is pinched in the middle? A moth's body is usually stocky and plump."

"I see," said Pinky. "Now I shall know how to find a moth. Thank you."

"And one more thing," said the butterfly.

"What's that?" asked Pinky.

"Butterflies sleep at night, moths don't!" snapped the butterfly. And it went straight back to sleep.

Pinky picked up his lantern. He hurried through the forest looking everywhere for some moths. He saw something sitting on a leaf. Its wings were folded back to back. He remembered and said, "That's not a moth."

He saw something resting on a twig. But its antennae had knobs on them. "That's not a moth, either," he said.

Then he saw a fat, furry fellow dancing in the light from his lantern. His body wasn't pinched in at all, and his antennae were quite feathery.

"Excuse me, but are you by any chance a moth?" Pinky asked.

"Of course I am," said the moth. "That's a silly question."

"Could you possibly come and dance for Princess Annabelle tonight?" asked Pinky. "It's her birthday and . . ."

"Be *de*lighted to," said the moth. "Moths enjoy dancing at night."

Pinky and the moth searched through the forest until they found 20 more moths. All said they'd be happy to dance for the princess.

The party was *wonderful*. Fireflies sparkled from every branch. Nightingales sang their pretty songs. And the moths did a graceful dance around the little princess. She clapped her hands in delight.

"Oh, Pinky," she cried. "Your moths are beautiful! I really love them most of all!"

"So do I," whispered Pinky, smiling with relief. "So do I."

THE END

Reprinted from *Ranger Rick* (Oct 83, pp 40–43)

Bugs, Bugs, Bugs

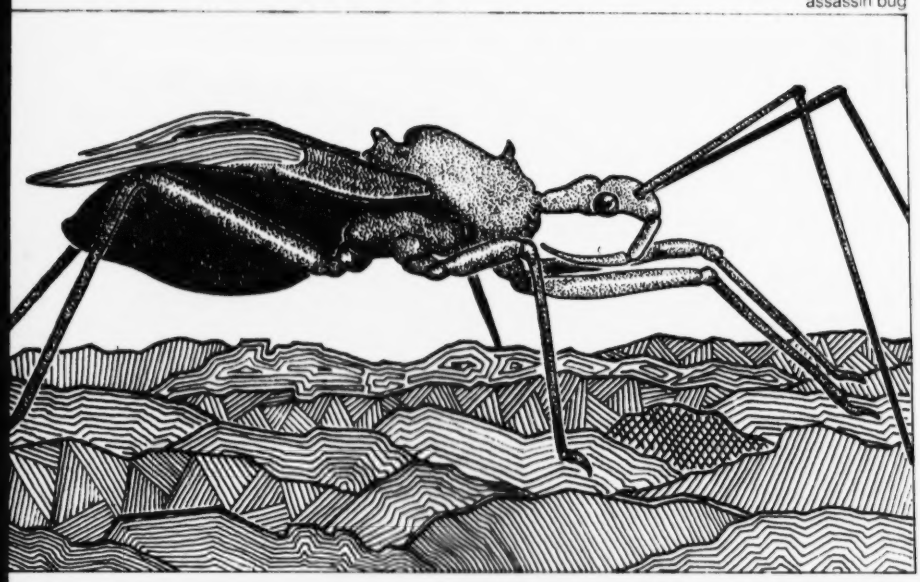
by Bugsy McBug

I'm a leaf-footed bug (that's my picture on the left), and I'm proud of it. So I really get "bugged" by people who think every creepy-crawly thing with legs is a bug. How many times have you heard someone scream, "*Ooooh*, it's a bug . . . get it out of here!"

Well, I'm tired of it! We bugs have gotten a bad name because most people don't know what is a real bug and what isn't. So I'm going to set the record straight now!

(continued next page)

assassin bug



stink bug

Bugology

We bugs are a very special group of insects. There are over 50,000 different kinds of bugs all over the world. Now that's variety! We bugs come in so many colors, sizes, and shapes that it's amazing, if I must say so myself. And there are bugs, I'll have you know, that can live almost anywhere. Some of us hide in flower blossoms or hang upside down from leaves. Many of my relatives dive in murky ponds (see far right) or live on sandy shores. Why, there's even a bug that skates on top of the ocean's waves.

Now you're probably mumbling to yourself, "Well if all bugs look so different, how can I tell what is a bug and what isn't?"

That's easy if you know what you're looking for. But to explain, I'll have to get a little technical for a minute. We bugs belong to a group of insects called the *hemiptera* (heh-MIP-ter-ah). This is a Greek word that means "half-wing." (*Hemi* means "half" and *ptera* means "wing.") Go ahead and lift up the front wing of a bug sometime (carefully, please). The upper half is tough and leathery, but the lower half is so thin you can almost see through it (see left).

You can sometimes see the two parts of our wings when we fly. But when we're not flying, it's much harder to see them. That's when people confuse us with beetles. (How dare they!) But if you look closely, our folded wings look almost like an X marked on our backs. That's another way to pick us out from a crowd of other insects.

You can also tell us bugs from other insects by looking at our mouths. Maybe you didn't even know that different kinds of insects have different kinds of mouths. Well, bugs have piercing-sucking mouths. They're like tubes with sharp points (see upper left). Our mouths are a lot different from the chewing mouths of grass-

Drawings by Jack Shepherd

hoppers or the lapping mouths of some flies. With our mouthparts, we suck juices from plants and animals almost the same way you suck up milk with a straw.

We keep our sucking tubes tucked under our bodies and out of the way while we're resting or crawling. But while feeding, we poke them straight out. The tip is so sharp it can *pierce*, or stab, plant stems, insects' bodies, or even people's skin.

I have another gripe. Some creatures have "bug" in their names, and they're not real bugs at all. Take lightning-bugs, for example. They're not bugs—they're beetles. And so are ladybugs.

Bug Birthdays

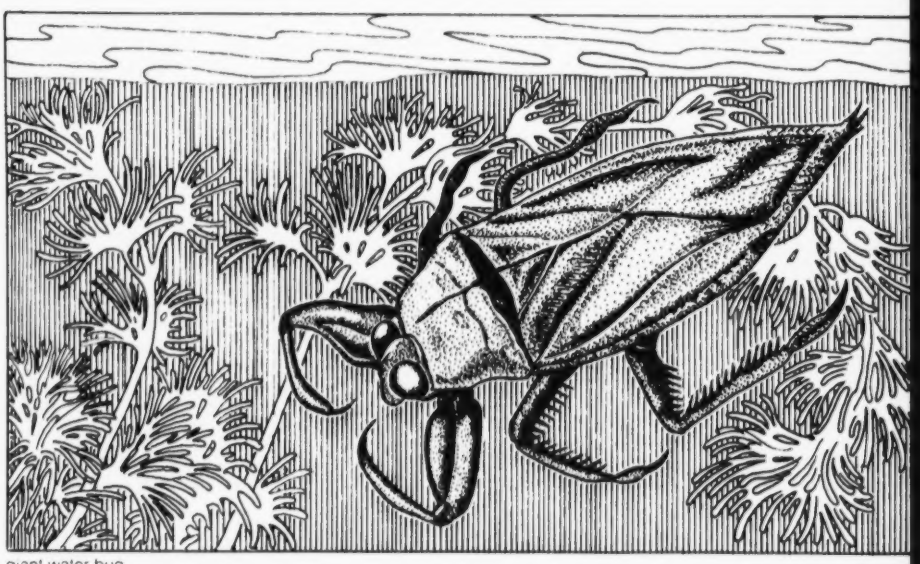
I'm almost four months old. Now that may not seem old to you, but it is for a bug. Most of us live less than a year.

During our short lifetime we go through three stages: egg, nymph, and adult. Scientists call this *incomplete metamorphosis* (met-uh-MORE-fuh-sis). Some insects, such as butterflies, beetles, and wasps, have four stages.

When we hatch from an egg, we look almost like a miniature copy of our parents. Of course, as a nymph, our wings haven't formed yet and we may be a different color. It takes us about five *molts* (skin sheddings) to change into an adult. Then it's time to find a mate.

Bug Food

Each kind of bug has its own juicy menu. A few bugs, such as bed bugs, suck blood from birds and other animals, including people. And some of my cousins, such as ambush bugs and assassin bugs, are expert predators. They often eat insects as well as other small creatures.



giant water bug

But like most bugs, my favorite meal is plant sap. U-m-m-m-m, there's nothing like the juice of a leaf for lunch. Some of us suck juice from many kinds of plants. Other bugs feed on just one kind. But our drinking habits get my friends and me into trouble. We can kill a plant by sucking it dry. That can be a big problem for farmers and gardeners. Some of my relatives even spread bacteria and viruses from one plant to another as they feed. And that can cause all kinds of plant diseases. (Oh well, I guess there is some good and bad in all of us . . . .)

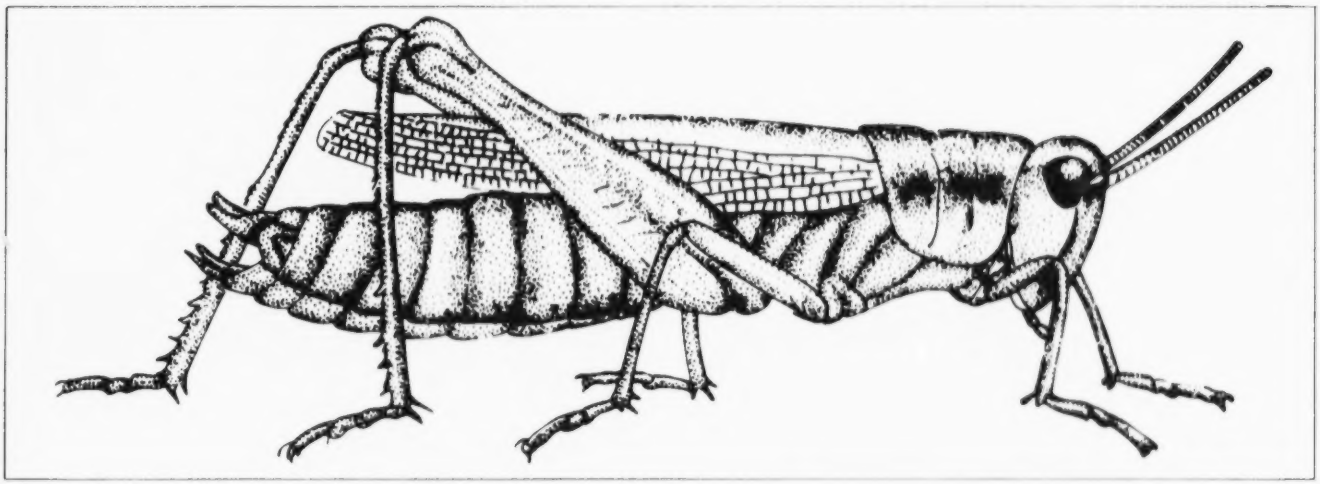
Don't Bug Me

We bugs provide food for many birds, spiders, fish, and other insects. (See, I told you some of us are good to have around.) But we do have ways to defend ourselves from enemies. One way is to stink. Many of us have stink glands on our undersides that give off a terrible-smelling goo. If you held me in your hand, you would quickly smell why enemies stay clear. (Personally, I don't think I smell half as bad as stink bugs do. . . .)

Other bugs keep safe by staying out of sight. Some, such as certain types of stink bugs, blend in perfectly with leaves, branches, or bark. Others, like the ambush bug, match the color of the flower they're hiding in.

Well, I guess I've rambled on long enough. I just wanted you to get the story straight from the bug's mouth. Just remember—if something crawls by, make sure it really is a real bug before you screech, "*Ooooh,* it's a bug!" We *real* bugs would appreciate it! ***THE END***

Reprinted from *Ranger Rick* (Nov 82, pp 2-7)



HOORAY FOR HOPPERS

by Diane Swanson

Your yard may be a "gymnasium" for some of the world's greatest athletes—grasshoppers! They can easily outhop humans and most other animals. And they're amazing in other ways too. But how much do you know about these leggy long jumpers?

What Makes Grasshoppers Such Great Jumpers?

If you look at the size of a grasshopper's hind leg, you can see what makes it a whopper of a hopper. Hundreds of tiny, strong muscles in their legs help grasshoppers shoot themselves forward in surprisingly long leaps. An average grasshopper can jump a distance 20 times its length. Humans can jump only about 5 times their height—and that's with a running start.

Do Hoppers Fly Too?

Most kinds of hoppers are able to fly. They have a broad back pair of wings and a narrow front pair. When the hopper's not flying, its tough front wings cover its delicate back ones.

How Many Kinds of Hoppers Are There?

There are about 5000 different kinds of grasshoppers living around the world. And

you can find them almost everywhere except in the Arctic and Antarctic. They live in marshes, deserts, rain forests, and fields.

Do Hoppers Lay Eggs?

They sure do! Grasshoppers mate in late summer or early fall. After mating, the female digs a hole in the soil using tiny hooks at the tip of her *abdomen* (AB-doh-mun). She lays 20 to 100 eggs in the burrow (see below). Then she squirts a thick, sticky foam over them. The foam hardens and keeps the eggs from getting moldy. Finally the female covers the burrow with dirt, leaving the eggs to hatch the next spring.

How Do Hoppers Grow?

When a hopper hatches it looks like a little, wingless adult. Like all insects, it has a hard, shell-like skin that protects its soft insides.

As it grows, the hopper molts by splitting its skin and crawling out of it. The new skin hardens, and the crumpled old skin's left behind.

Most grasshoppers molt six times before they reach their full adult size and develop wings. That usually takes forty to sixty days. A hopper's full size depends on what kind of hopper it is. The largest species is about six inches long. The smallest species is less than one-quarter of an inch long.

How Do Hoppers Hear?

Grasshoppers hear sounds with their eardrums, as you do. But their ears aren't on their heads. They're on the sides of their abdomens and look like small spots.

Do Grasshoppers Make Sounds?

Many kinds of hoppers never make any sounds. But some species do, and each has its own buzzy "song." The song is used by male hoppers to call for a mate. Most grasshoppers "sing" by scraping their back legs along their front wings as if they were fiddling. Other species try to attract females by making a loud, crackling noise with their wings when they fly.

What Do Grasshoppers Eat?

Grasshoppers eat grasses and other plants. They have strong jaws that are great for chomping. And hoppers eat a lot too. Sometimes they become a problem to farmers by eating their crops.

What Eats Them?

Many creatures, including other insects, snakes, spiders, owls, skunks, monkeys, and lizards will eagerly gobble grasshoppers. And believe it or not, in some countries there are people who think that hoppers make delicious and crunchy snacks!

Do Hoppers Ever Get Out of Control?

In some parts of the world there are grasshoppers called *locusts*. During times when they have plenty of food, the locusts multiply rapidly. Then their numbers grow very large. When this happens they form a *swarm*—a group of millions or billions of locusts.

Swarms often take to the sky, and some have been large enough to block out the sun. They fly great distances, eating crops and other plants along the way. A swarm of locusts can destroy a field of crops in just a few hours.

How Do Hoppers Protect Themselves?

If you've ever tried to hold a hopper, you may have ended up with brown liquid on your fingers. This liquid is bad-tasting stuff that hopper enemies usually don't like.

Some hoppers have another trick to keep from being eaten. They keep out of sight. Many blend in with their surroundings so well, it's almost impossible to spot them.

But most hoppers stay out of trouble by relying on their strong legs to carry them to safety. After all, hopping is what hoppers do best!

THE END

Drawing by Biruta Akerbergs

Reprinted from *Ranger Rick* (Aug 87, pp 22-29)

by Diane Swanson

Lightning lit up the night sky. Thunder rolled and roared. A thin, old man rushed to his windows and flung them wide open. The French naturalist, Jean Henri Fabre (ZHAHN ahn-RIE FAH-br), was enjoying his favorite nature show.

Thunderstorms thrilled him. He loved all forms of nature and studied as many as he could—wind and water, flowers and frogs, and many more.

THE MAN WHO LOVED INSECTS

Best of all Jean Henri Fabre loved to study insects. Their busy lives were mysteries he found even more exciting than thunderstorms: Giant peacock moths that never ate! Caterpillars with invisible poisonous prickles! Hunting wasps that paralyzed their prey! Jean Henri Fabre was eager to learn all he could about the amazing insect world.

But in the 1800s when he lived, very little was known about how insects behaved. Hardly anyone had studied insects to find out where they lived, how they mated, or how they gathered food and defended themselves. So Fabre devoted most of his life to studying the insects of southern France.

Jean Henri Fabre was always very poor. His home was also his laboratory. The only tools he had were tweezers, a penknife, a trowel, and his magnifying glass. He often said that time and patience are the best tools of all.

His methods for learning were simple: He was a very careful observer, and he designed simple experiments to test his ideas. For example, one night Jean Henri put a glass jar over the nest of some ground wasps. In the morning the wasps tried again and again to fly out through the glass. Although these wasps were excellent diggers, not one tried to dig its way out underneath. Their instincts told them only to fly up toward the light. The wasps just couldn't understand the strange, clear glass wall.

Another time, on a warm winter day, he saw 300 processionary (pro-SESH-un-air-ee) caterpillars marching down a pine tree in his yard. They came one right after the other. As they moved, each caterpillar left a silk thread that joined with those that

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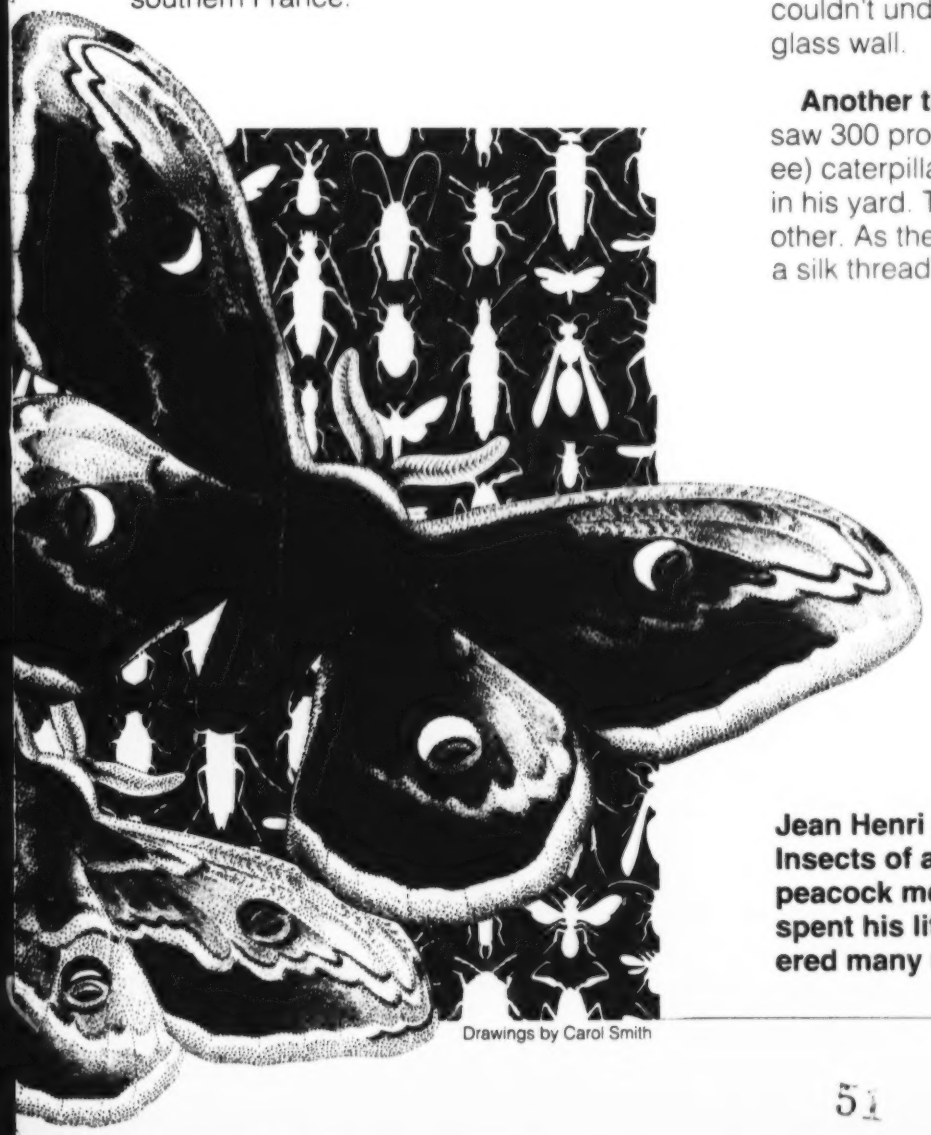


Drawings by Carol Smith

Jean Henri Fabre was a French peasant. Insects of all kinds, such as these giant peacock moths, fascinated him, and he spent his life studying them. He discovered many new things about them.

others had made. The caterpillars would follow this silk trail back to their nest.

Then Jean Henri spotted them going around the top of a large vase in his garden. As an experiment he brushed away the silk trail leading from the ground to the top of the vase. The caterpillars now had only a single "road" to follow around the top. Around and around they went—for days! Never stopping, they had nothing to eat and no shelter during the night. Finally they were so tired they fell off the vase. Then they soon found their old silk road on the ground and followed it back to their nest.

Jean Henri always repeated his experiments with insects many times. If the animals acted the same way each time, he could be sure that what he had thought about their behavior was true.

Jean Henri Fabre had loved science even when he was very young. At six he was exploring sandbanks and crawling through weeds. He collected leaves, rocks, and beetles. At ten he discovered how to put a turkey to sleep—by tucking its head under one wing and rocking it for a moment. Then he put it down on its side and the bird didn't move.

Fifty years later Fabre tried it with another turkey. He was studying turkeys and the strange, trancelike sleep of some birds and insects.

Jean Henri Fabre could never afford much schooling. But he became Dr. Fabre—a doctor of science—by teaching himself many subjects. He taught school for many years, and his love of science spread to his students. On Sundays his students joined him in the fields with magnifying glasses and watchful eyes.

On many of his field trips, Dr. Fabre would sit alone for hours, watching beetles burying a dead mole or flies laying eggs. Some people thought he was crazy. Once he was almost arrested for lying on the sand while watching some wasps. A police officer said, "You'll never make me believe you come here and roast in the sun just to watch flies!"

Jean Henri Fabre was 55 years old before he was able to buy two and a half acres of rocky land in a small village. Here he could study for the rest of his life without being bothered. His land was full of thistles and brambles that hummed with insects. A pond in front of the house attracted mating frogs and toads. On spring evenings they were so noisy, it was almost impossible to talk or sleep. It was a place most people would hate. But for Dr. Fabre it was heaven.

Jean Henri had walls built around his yard to shut himself in. He lived there with his family, studying and writing about his backyard wildlife.

At six each morning he began work by checking his beetles and bees outside. Then he went into his lab—a long room filled with insect cages made from old boxes or flowerpots. He worked so many hours around his table that his footsteps wore a path into the floor.

Although Dr. Fabre worked alone, his favorite helpers were children. Their natural curiosity was like his own. Sometimes they helped him find special insects he wanted to study. Or they told him they had seen an insect behaving strangely out in the field. Jean Henri rewarded them with a small coin or a slice of bread and jam.

His own children were especially good helpers. Hand in hand with their father they learned about the nature he loved. When only seven years old, his son Paul was a near-expert on grasshoppers, crickets, and dung beetles.

One of Paul's biggest thrills came from the great peacock moth, Europe's largest

moth. One day a female came out of her cocoon in Dr. Fabre's laboratory. That evening 40 male peacock moths came through the open window to mate with the red velvet beauty. Paul discovered them on his way to bed. "Come quickly!" he yelled. "Come and see these moths—big as birds! The room is full of them!"

As he studied, Jean Henri Fabre carefully wrote down his ideas about everything he had seen. He wrote a set of science books for students about everything from scorpions to sunshine. He made hard ideas seem simple and interesting. After a while Jean Henri Fabre's books were used to teach science throughout France.

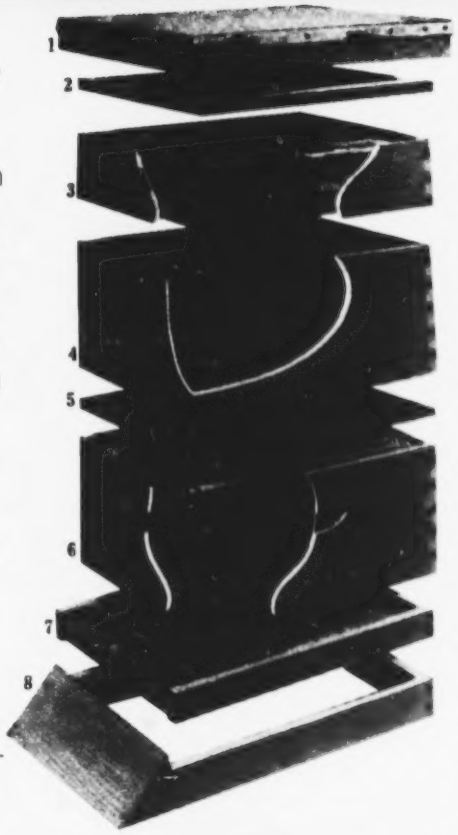
He was 84 years old before his work was really appreciated. But when people finally knew how much he had given to science, they planned a great celebration in his honor. Many famous scientists and important officials came to his home to honor him.

Jean Henri was still humble as ever. He was glad students were reading his books. But he didn't like anyone to make a fuss over him. He took time to talk if someone wanted to ask a question, but for celebrations he was too busy.

When he heard that France was putting up a statue of him, he didn't even look up from the moth he was studying. "But shall I recognize myself?" he asked. "I've had so little time for looking at myself."

Jean Henri Fabre's love of nature lasted as long as he lived . . . 92 years! In 1915 he died at home—a humble peasant and France's greatest naturalist. ***THE END***

Reprinted from *Ranger Rick* (Jan 80, pp 12-15)



Drawing by Frank Fretz

If you took a hive apart in late summer, you'd find these parts: 1. outer cover, 2. inner cover, 3. honey super, 4. honey (food) chamber, 5. queen excluder (keeps queen out of food chamber), 6. hive body (brood chamber), 7. bottom board, 8. stand

THE BEES AND ME

by Jonathan Walley

I've got 60,000 bees in my backyard! But that's normal for my house. My dad and I are beekeepers. We've been keeping bees for two years and it's been great. Besides the fun, we get to eat honey all year long.

It all started when we saw a TV show about insects. On the program, a beekeeper captured a swarm of bees, and she talked about how easy it was to keep bees. I said, "I sure wish I could do that."

Instead of laughing, my dad said, "Let's try it!"

The next week my dad signed up for a beekeeping class at our local nature center. The classes were pretty late at night, so I didn't go. But the morning after each class, Dad would tell me everything he learned.

First I found out that there are three different "kinds" of honey bees in each hive—one queen, thousands of workers, and hundreds of drones. The queen is very important. She lays all the eggs for the colony. She also keeps the hive together by giving off a special chemical scent. The other bees in the hive can smell this chemical. The scent seems to tell them, "I am your queen and this is your hive."

Most of the bees in a colony are female workers. Just as their name says, they do all the work for the hive. They collect nectar, water, pollen, and bee glue (sap from trees). They make honey, feed the young, guard and clean the hive, and take care of the queen. There are also drones in a hive. These are the male bees. They have only one important job—to mate with the queen.

In the wild, bees live in dark, secluded places such as hollow trees. But when people keep bees in their backyards, they keep them in special wooden boxes called hives. After we learned about the parts of a beehive, my dad bought a kit to make one. It came with a lot of pieces that had to be put together. With me helping, it didn't take long to get it all set up.

The main part of the hive is in two sections. The bottom part is called the brood chamber. (*Brood* is another word for the eggs, larvae, and pupae.) This is where the queen will lay her eggs. The food chamber goes on top of the brood chamber. This is the part of the hive where the bees will store their honey (see diagram).

Once we got the hive together, we were ready for our bees. We ordered them from a beekeeper in Virginia. Can you believe that the bees came in the mail—all 9000 of them! They were in a cage about twice the size of my lunchbox. I watched as Dad opened the cage and gently dumped the bees into the hive. We both had dressed up in our beekeeper outfits—long pants, long-sleeved jackets, gloves, hats, and veils. But I'll tell you I was still a little scared. It's really weird having bees buzzing all around you while you work.

In about two days, the worker bees began to make wax. The wax comes from special glands on the underside of each worker's body. The wax is white and comes out as a flat flake. The bees chew it

with their jaws, then use it to build the six-sided cells that make up the *comb*. The cells will be used for storing honey, nectar, and pollen, and for raising the young.

Since the bees hadn't stored any honey yet, Dad and I fed them sugar water during their first few weeks. But it wasn't long before the bees were busy collecting nectar and making honey.

When the bees return to the hive with nectar, they transfer it from their *honey stomachs* into the cells of the comb. Then they slowly change it into honey. To do this, the worker bees fan the nectar with their wings. The fanning gets rid of some of the water in the nectar (by *evaporation*) and slowly turns the nectar into honey. Once the bees start making honey, they don't need the sugar water anymore, so we take it out and put the other frames of wax back in.

Every time we go into the hive, we use a *smoker* to calm the bees (see below). We burn burlap or sticks inside to make smoke come out the end.

By the middle of the summer, the hive was full of bees and honey. My dad said that there were probably 60,000 or 70,000 bees in there! He decided it was time to add a *honey super*. This is a smaller section that can be added on top of the food chamber. The bees would store honey in this too. But this would be *our* honey. We're lucky that honey bees make a lot more honey than they need. In a good year, a hive can make over 100 pounds of extra honey.

Some people get upset when they see bees flying free around the hive. They think that honey bees are mean and will attack anyone they see. But that's not true. A honey bee doesn't sting unless it has a reason. When a worker bee stings, it dies because the stinger and part of its gut are pulled out. If we tried to hurt the bees or the hive, then they would sting us. But they seem to know that we won't bother them.

Bees really are pretty easy to keep. We only need to inspect the hive every few weeks in summer. Then in early fall we *extract*, or take out, the extra honey from the frames in the super. The bees cap the honey cells with a wax coating. We use an electric knife to cut off the wax and let the honey drip out of the cells.

In winter, the bees take care of themselves. During the cold months, the bees huddle around the queen, keeping each other warm. Some of the workers die from the cold anyway. And in a very cold winter, a whole hive may die.

At the end of our hive's first winter, we were really worried. It had been so cold that we were afraid the bees might have died. Boy, were we excited when we saw that they were alive and buzzing!

You know, it makes me mad when people say they don't like honey bees. These little insects help people all the time. They pollinate many of our plants and give us lots of honey. Who could ask for better neighbors?

THE END

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Drawing by Kim Kerin
(From a photo by Sidney A. Tabak)

Voyage to Hexatron

by Judy Braus

JJ picked up a stone from the bank of the stream where he was sitting. He flung it into the water. "That stupid bee!" he said, looking at the sole of his foot. "What a place for a bee sting! How am I going to play softball tomorrow?" But no one except his dog, Sammy, was there to listen.

"Maybe it'll help if I soak it," he said, dipping his foot in the cold water. Sammy just looked at him and scratched her belly with her hind paw.

"See! Bugs—fleas—are after you too! I tell you, Sammy, I've had it. I wish all insects would die. Who needs them? All they do is bite or sting or sometimes make you sick!"

Suddenly JJ heard a loud hum. "Ouch!" he cried and slapped his neck, just in time to squash a big mosquito. He wiped the dead insect off his hand.

"Another one!" he exclaimed as he scratched the itch. JJ sighed and closed his eyes. He laid his head down on the soft moss. "Yeah, wouldn't it be nice . . . a world without insects . . . without any insects at all . . . ."

Suddenly he woke with a start. Someone was tying him up! JJ struggled to get free, but he couldn't budge. Then he saw that he was wrapped tightly in a cocoon of white silk! JJ rolled over and looked up. There was the biggest caterpillar he had ever seen, spinning silk from its mouth. In no time Sammy too was covered with a silken mummy case.

"Hey, I can't move . . . what's going on?" demanded JJ.

Taken prisoner by a fat, fleshy caterpillar, JJ and his dog end up in a strange new world.

Out of This World and into Another

The caterpillar turned its fat green body slowly around. In a deep voice it said, "You are on your way to Hexatron, the planet of the insects. Your trial is scheduled for today."

"Trial? What trial?" asked JJ. "Am I going crazy? Caterpillars can't talk."

"Oh yes, we can. All insects can talk on Hexatron."

Then the caterpillar reared up on its hind legs and signaled to the sky with its front feet.

Within seconds a roar filled the air. Sammy whimpered and JJ looked up nervously. He couldn't believe his eyes. A huge dragonfly zoomed into view.

"Here they are, Anisop. You'd better hurry. You know the judge doesn't like to be kept waiting," the caterpillar said in its deep voice.

The caterpillar quickly tied JJ and Sammy to the dragonfly's back with a thick piece of silk. In the wink of an eye Anisop rose into the air. Up, up, up they sailed—through wispy clouds of pink and charcoal. JJ saw the earth get smaller and smaller until it disappeared.

"Where are you taking us?" JJ yelled to the dragonfly. But the dragonfly's wings were making so much noise that JJ's voice was lost.

Suddenly a tiny dot of orange appeared in the distance. It grew bigger and bigger until it seemed enormous.

"It's a planet, Sammy," shouted JJ.

But Sammy just whimpered softly and closed her eyes.

Anisop circled around, then zipped in and landed on a path.

JJ gazed around in amazement. The place looked like earth, but there were huge insects everywhere. Lots of crazy noises swirled around his ears—high-pitched chirps, whines, trills, and hums.

Suddenly three huge beetles marched quickly up the path. JJ and Sammy, still strapped to Anisop, trembled.

"The trial's about to begin," the largest beetle reported. "The judge asked us to bring the prisoners to her immediately."

With sharp jaws, two beetles cut JJ and Sammy from Anisop's back and pulled off the cocoons. JJ and Sammy followed the beetles into a huge cave. The air was cold and musty, just like JJ's basement at home. A loud humming filled the air.

Soon JJ was standing in a courtroom. The judge was a huge preying mantis perched behind a low wall at the front of the room. On her right a honey bee guard stood at attention.

"Look, Sammy, an insect jury!" whispered JJ. The jury was made up of flies, beetles, ants, grasshoppers, and some insects JJ had never seen before.

There were hundreds of insect spectators in the courtroom too, buzzing, chirping, and humming away.

"State your name," the stern-faced judge commanded.

"I'm JJ, and this is my dog, Sammy."

Sammy growled a low growl.

"Silence!" the judge shouted. "You are charged with betraying insects! How do you plead?"

"Betraying insects?" asked JJ in amazement.

"The evidence, please," the judge demanded.

Guilty or Not Guilty?

A beetle stepped up to the stand. "Your Honor, the accused said insects don't do any good. He said he hated all of them and wished they'd all die."

The jury began to mumble and buzz.

Then a mosquito said, "I heard him say that the earth would be better off without *any* of us!"

And a honey bee worker got up and reported, "He said we're no good to people. *No good!*"

"Enough!" cried the judge. "Jury, have you reached a verdict?"

"Guilty!" the jury cried together.

"You have been declared guilty of be-

(continued next page)

traying insects," stated the judge. "I now sentence you to work at two insect tasks. Now go, but leave your dog here."

"Your first task will be with the pollinators," said the guard bee.

"The *what*?" asked JJ.

"Never mind—you'll find out. Put on this cloak," the bee directed.

As soon as JJ touched the cloak, he changed into a bee! There were hairs all over his body and pollen baskets on his hind legs.

All afternoon he and the other worker bees sucked nectar from flowers and collected pollen.

This is kind of neat, thought JJ. *I wouldn't mind having six legs and being able to fly all the time.*

But by the time the sun had set, JJ was exhausted. "Why do you need so much?" he asked one of the other bees.

"We take nectar back to the hive and make it into honey. It's food for all of us. We eat most of the pollen too. But some we carry from flower to flower. That helps them make fruit and seeds. Without bees and other insects there wouldn't be any oranges or apples, as well as lots of other fruits and vegetables, for you to eat."

"Gosh, I'd hate to go without fruit," said JJ.

Then suddenly JJ saw a bright flash in the sky.

"It's the signal," said the bee. "It's time to start your second task."

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The Final Punishment

JJ and the bees zoomed down to a rotting log and met three brightly colored beetles.

"I'm Cara, leader of the carrion beetles of Hexatron. Eat this fungus, JJ, and you too will become a carrion beetle."

As the beetles and JJ flew off, JJ's antennae began to pick up an odor. Soon he and the beetles reached the body of a rabbit. It had been dead a long time. A lot of the meat was already gone. There were beetles, flies, bees, and ants all over the decaying meat. Bit by bit JJ and the other insects cleaned off the meat that was left.

"So this is what happens to all the dead animals in the woods. These insects help keep the woods clean," JJ said aloud.

Just then Anisop landed beside him.

"From what I just heard, my friend, I believe you're learning something," said Anisop, smiling for the first time.

"But many insects help you in ways you haven't even thought about. Take mosquitoes . . . they are food for dragonflies and many fish, frogs, and other pond animals. In fact, many animals depend on insects for food. Why, without us, some birds, reptiles, amphibians, and even some mammals would have to change their diets or die."

"I just never thought of that," said JJ.

"Now I think you're ready to see the sacred Insect Gallery of Life. Follow me," said Anisop.

They swooped down into an extinct volcano. Inside the cone was a massive museum.

"I want you to see for yourself how important insects really are," said Anisop. And then he flew quickly out of sight.

JJ looked around. He walked up to one display. It was a picture of a huge cockroach. Underneath it read: "*Blatty the Great*. Blatty and her offspring were the most famous cockroaches in history. They helped scientists learn how the nerves in humans and other animals work."

JJ walked around to another display. It was filled with things made by insects. There were silk gowns made from the silk of moths, beeswax candles, and lots of other products.

But the display JJ liked best was a photo show. There were pictures of shimmering beetles and glowing fireflies and multicolored butterflies.

"Gosh, I didn't know there are so many beautiful insects, or how much good they do," said JJ in admiration.

Suddenly JJ slipped and fell over a log near one of the displays. Over and over he tumbled in the darkness. In a moment or two he opened his eyes. There he was, back on the stream bank. Sammy was asleep with her head in his lap.

"I'm *me*! I'm me again! And you're you, Sammy!" shouted JJ.

Just then a beautiful dragonfly zoomed by and snatched a mosquito from the air.

"You know, Sammy, we're pretty lucky to have insects around, aren't we?" JJ said.

Sammy just wagged her tail happily.

THE END

Drawings by Jeff Seaver

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